M.Sc. Data Science

Syllabus

UNIVERSITY DEPARTMENT

Program Code: ****

2023 – 2024 onwards

BHARATHIAR UNIVERSITY

(A State University, Accredited with "A++" Grade by NAAC,
Ranked 21st among Indian Universities by MHRD-NIRF)

Coimbatore - 641 046, Tamil Nadu, India

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)	
The M.Sc. Data Science programme describe accomplishments that graduates are expected to attain within five to seven years after graduation	
PEO1	Excel in his/her professional career and/or pursue higher education including research by applying the knowledge of data science.
PEO2	Graduates will be capable to become leaders, equipped with managerial and analytical skills needed for data driven decision making.
PEO3	Graduates are prepared to meet industry demand in the field of data science with proficiency in statistical methods and data analytics tools.
PEO4	Graduates will be engaged in lifelong learning and progress into research and development in data analytics.
PEO5	Graduates will apply data science concepts and methods to solve problems in real-world contexts and will communicate these solutions effectively.

PROGRAMME SPECIFIC OUTCOMES (PSOs)	
After the successful completion of M.Sc. Data Science programme, the students are expected to	
PSO1	Develop core competence in science, mathematics and fundamentals of data science to address ever-changing industrial requirements globally.
PSO2	Develop sustainable solutions for society.
PSO3	Become a skilled data scientist to meet out the industry standards.
PSO4	Develop domain-specific software tools for data storage, analysis and visualization.
PSO5	Able to independently carry out research/investigation to solve practical problems

Program Outcomes (POs)	
On successful completion of the M. Sc. Data Science program	
PO1	Gain and apply the knowledge of data science concepts in appropriate domain of interest
PO2	Ability to analyze the problem, identify the required computing facility and implement it to obtain solutions
PO3	Ability to create a new design for the complex computational problems which meets the specific needs for environmental and societal impact domains
PO4	Students can independently enable to acquire the innovative ideas and solve complex real-time problems by considering professional, ethical, legal and social issues
PO5	Understand and choose the appropriate modern techniques and tools for the complex systems of various domains and understands the advantages and limitations
PO6	Ability to work in a group with an effective rapport building with team members in computer industries to accomplish a common goal
PO7	Ability to communicate effectively in the basis of presenting their research work and gain knowledge on documentation and reports writing in a professional way
PO8	Ability to distinguish the ethical, legal and societal issues of computing surroundings and will take the responsibility by applying computer skill practices
PO9	Ability to analyze the local and global impact of computing on individuals, organizations and society
PO10	Demonstrate the principles of data science and apply these in the multidisciplinary environments to manage project

BHARATHIAR UNIVERSITY:: COIMBATORE 641 046
M.Sc. Data Science Curriculum (University Department)
(For the students admitted during the academic year 2023 – 2024 onwards)

Course Code	Title of the Course	Credits	Hours		Maximum Marks		
			Theory	Practical	CIA	ESE	Total
FIRST SEMESTER							
23DS1C1	Linear Algebra	4	4	-	25	75	100
23DS1C2	Probability and Statistics	4	2	4	25	75	100
23DS1C3	Principles of Data Science	4	4	-	25	75	100
23DS1C4	Database Management Systems	4	2	4	25	75	100
23DS1C5	Python and R Programming	4	2	4	25	75	100
23DS1EX	Elective-I	4	4	-	25	75	100
1GS	General Supportive -I	2	2	-	12	38	50
	Job Oriented Course	2	2	-	50	-	50
	Total	28					700
SECOND SEMESTER							
23DS2C1	Optimization Techniques Using MATLAB	4	2	4	25	75	100
23DS2C2	Multivariate Data Analysis	4	2	4	25	75	100
23DS2C3	Machine Learning Techniques	4	2	4	25	75	100
23DS2C4	Data Mining	4	4	-	25	75	100
23DS2C5	IoT Analytics	4	4	-	25	75	100
23DS2EX	Elective-II	4	4	-	25	75	100
2GS	General Supportive-II	2	2	-	12	38	50
	Job Oriented Course	2	2	-	50	-	50
	Total	30					700
THIRD SEMESTER							
23DS3C1	Big Data Analytics	4	2	4	25	75	100
23DS3C2	Deep Learning Techniques	4	2	4	25	75	100
23DS3C3	Data Privacy and Security	4	4	-	25	75	100
23DS3EX	Elective-III	4	4	-	25	75	100
23DS3EX	Elective-IV	4	4	-	25	75	100
23DS3MP	Mini Project	4	-	-	25	75	100
3GS	General Supportive-III	2	2	-	12	38	50
	Value Added Course	2	-	-	50	-	50
	Total	28					700
FOURTH SEMESTER							
23DS4PW	Project Work	12	-	-	180	120	300
	Value Added Course	2	-	-	50	-	50

	Total	14					350
	Grand Total	**98**					**2450**

Online Course

	SWAYAM – MOOC Course*	2					

*Swayam – Mooc online course shall be for duration of atleast 4 weeks with atleast 2 credits. The course shall be mandatory and shall be completed within third semester(i.e., before the beginning of fourth semester)

Elective Papers

Sem	Elective	Suggested Code	Title of the Paper	No. of Credits
I	Elective – I	23DS1E1	Design of Algorithms	4
		23DS1E2	Artificial Intelligence	4
		23DS1E3	Business Intelligence	4
II	Elective – II	23DS2E1	Transforms and Applications	4
		23DS2E2	Predictive Analytics	4
		23DS2E3	Software Project Management	4
III	Elective – III	23DS3E1	Natural Language Processing	4
		23DS3E2	Social Media Analytics	4
		23DS3E3	Health Care Analytics	4
		23DS3E4	Nature Inspired Computing	4
	Elective – IV	23DS3E5	Cloud Security	4
		23DS3E6	Sentiment Analysis	4
		23DS3E7	Text Analytics	4
		23DS3E8	Digital Marketing Analytics	4

List of Job Oriented/Value Added Course

1. Data Analysis using Excel
2. Power BI for Data Analytics
3. Software Testing Tools

4. Cyber Security and Digital Forensics


First
Semester

Course code	23DS1C1	LINEAR ALGEBRA	L	T	P	C
Core/Elective/Supportive		CORE	4	0	0	4
Pre-requisite:		Basic knowledge in higher secondary algebra	Syllabus Version		2022-2023	

Course Objectives:

The main objectives of this course are to:
1. Learn the elementary concepts and basic ideas involved in matrix theory
2. Particular attention is given to canonical forms of linear transformations, diagonalizations of linear transformations, matrices and determinants.
3. Applications to linear models and Inner product spaces are also analyzed.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

CO1	Determine whether a square matrix is diagonalizable, and compute its diagonal lization.	K2
CO2	Find the minimal polynomial and the rational forms of a real square matrix.	K3
CO3	Compute the eigenvalues and eigenvectors of a square matrix and determine the dimension of the corresponding eigenspaces.	K4
CO4	Discuss the kernel and image of linear of a linear transformation in terms of nullity and rank of a matrix.	K5
CO5	Applications to linear models such as curve fitting, regression etc.,	K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit 1	**Linear Equations in Linear Algebra**	**12 hours**

Systems of linear equations-Row reduction and Echelon forms-Vector Equations-Matrix equations Ax=b-Solution set of linear systems-Applications of linear systems-Linear Independence-Introduction to linear transformations-The matrix of linear transformation-

Unit 2	**Matrix Algebra**	**14 hours**

Matrix operations-The inverse of a matrix-Characterizations of Invertible Matrices-Partitioned Matrices-Matrix factorizations-Subspaces of R^n-Dimension and Rank

Unit 3	**Vector Spaces**	**14 hours**

Vector spaces and subspaces-Null spaces, Column spaces and linear transformations-Linearly independent sets: Bases-Coordinate systems-The dimension of a vector space-Rank-Change of Basis

Unit 4	**Eigenvalues and Eigenvectors**	**15 hours**

Eigenvectors and Eigenvalues-The Characteristic equations-Diagonalization-Eigenvectors and linear transformations-Complex eigenvalues.

Unit 5	**Orthogonality and Least Squares**	**18 hours**

Inner product, length and orthogonality-Orthogonal sets-Orthogonal projections-The Gram-Schmidt Process-Least square problems-Applications to linear models-Inner product spaces-Applications of Inner product spaces

Unit 6	**Contemporary Issues**	**2 hours**

Expert lectures, online seminars - webinars

	Total Lecture hours	**75 hours**

Text Book(s)

1	"Linear Algebra and its Applications" by **David C. Lay, Steven R. Lay, Judi. J. Mcdonald,** Fifth Ed., 2016 Pearson. Unit I : Chapters 1: Sections:1.1-1.9; Unit II : Chapters 2: Sections:2.1-2.5, 2.7-2.9; Unit III : Chapters 4: Sections:4.1-4.7; Unit IV : Chapters 5: Sections:5.1-5.5 Unit V : Chapters 6 : Sections:6.1-6.8
Reference Book(s)	
1	**Gilbert Strang**, Introduction to Linear Algebra, Fifth Edition, 2016
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/courses/111104137
2	https://nptel.ac.in/courses/111106051
3	https://ocw.mit.edu/courses/18-06-linear-algebra-spring-2010/
Course Designed By: **Dr. R. Rakkiyappan**	

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	M	M	S	M	L	M	S	M
CO2	S	S	M	M	S	M	M	M	M	M
CO3	M	S	L	S	M	M	M	S	S	M
CO4	M	S	S	S	S	M	M	M	M	M
CO5	M	S	S	S	S	L	M	S	S	S

* S- Strong; M-Medium; L-Low

Course Code	23DS1C2	PROBABILITY AND STATISTICS	L	T	P	C
Core/Elective/Supportive		CORE	2	0	4	4
Pre-requisite		Basics of Mathematics and Statistics	Syllabus Version		2022-2023	

Course Objectives

The main objectives of this course are to:

1. Inculcate the knowledge on descriptive statistics
2. Impart the concept of probability and its applications
3. Know the distributions and its variants
4. Learn the various sampling techniques
5. Understand the concept of inferential statistics for decision making

Expected Course Outcomes

On the successful completion of the course, student will be able to:

1	Visualize and summarize the data	K1-K3
2	Know the usage of probability concept in a given situation	K2-K3
3	Select a suitable distribution and also to generate random sample	K3-K5
4	Draw sample by choosing suitable sampling techniques and estimate the parameters	K3-K5
5	Formulate hypothesis and perform suitable tests.	K2-K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit 1	Descriptive Statistics	12 hours

Raw Data – Graphical Plots and Charts - Frequency Distribution – Histogram and Frequency Polygons – Relative Frequency Distributions – Cumulative Frequency Distributions – Frequency Curves and Their Types - Measures of Central Tendency: Mean, Median, Mode, Trimmed Mean – Measures of Dispersion: Range, Standard Deviation, Quartile Deviation, Mean and Median Absolute Deviation – Moments - Measures of Skewness and Kurtosis – Notion of Linear Correlation and Linear Regression – Simple Problems.

Unit 2	Basic Probability, Random Variables and Probability Distributions	12 hours

Concept of Probability – Axioms of Probability - Conditional Probability – Simple Problems - Independent Events - Bayes' Rule (without proof) and Simple Applications. Discrete and Continuous Random Variables, Probability Distributions for Discrete and Continuous Random Variables – Distribution Functions for Discrete and Continuous Random Variables - Joint Distributions - Independent Random Variables - Probability Distributions of Functions of Random Variables – Marginal and Conditional Distributions – Mathematical Expectation.

Unit 3	Special Probability Distributions	12 hours

Notions of Binomial, Poisson Distribution and Normal Distributions – Properties – Relationship Between Binomial and Normal Distributions, Poisson and Normal Distributions – Uniform, Exponential, Gamma Distributions, t, Chi-square and F Distributions - Bivariate Normal Distribution – Simulation: Random Number Generation from Exponential, Gamma and Normal Distributions.

Unit 4	Sampling Theory and Statistical Estimation Theory	12 hours

Population and Sample - Random Samples – Sampling With and Without Replacement, Sampling Distributions, Sampling distributions of Mean, Proportion and Difference of Means, Standard Error. Estimation of Parameters, Properties of Estimators: Unbiasedness, Consistency, Efficiency,

Sufficiency. Point and Interval Estimates and Their Reliability, Confidence Interval Estimates of Population Parameters Based on Normal, t and Chi-square Distributions.		
Unit 5	**Statistical Decision Theory**	**12 hours**
Statistical Decisions, Statistical Hypothesis, Tests of Hypothesis and Significance, One-tail and Two-tail Tests. Parametric Tests: Tests Involving Normal, t, Chi-square and F Distributions - Test for Goodness of Fit, Contingency Tables, Tests for Independence of Attributes, One-way and Two-way Analysis of Variance. Non-parametric Tests: Sign Test, Run Test, Wilcoxon Signed Rank Test, Mann-Whitney U test, Kruskal-Wallis Test.		
Unit 6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – webinars		
	Total Lecture hours	**62 hours**

Reference Books	
1	Montgomery, D. C., and Runger, G. C. (2018). Applied Statistics and Probability for Engineers, Seventh Edition, John Wiley & Sons, Inc.
2	Bruce, P., Bruce, A., and Gedeck, P. (2020). Practical Statistics for Data Scientists, Second Edition, O'Reilly Media, Inc.
3	Spiegel, M. R., Schiller, J. J., and Alu Srinivasan, R. (2013). Probability and Statistics, Fourth Edition, Schaum's Outline Series, McGraw Hill Companies, Inc.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/courses/111104032
2	https://nptel.ac.in/courses/111106112
3	https://nptel.ac.in/courses/111104120
Course Designed By: **Dr. R. Vijayaraghavan / Dr. R. Muthukrishnan**	

***Note*: This paper is application oriented. The derivation of the formulae and equations is outside the scope of the paper and hence, it may be avoided.**

PROBABILITY AND STATISTICS LAB

List of Programs

Problems relating to the following topics using R / Python programming shall form the basis for setting the question paper.

1. Formation of frequency tables – one way and two-way tables.

2. Graphical and Diagrammatical representation of data - Bar plot, line plot, pie chart, multiple bar plot, stacked bar plot, histogram, frequency curves, boxplot, steam-leaf plot, scatter plot.

3. Computation of Descriptive measures – mean, median, mode, trimmed mean, range, standard deviation, median absolute deviation, quartiles and percentiles. **Computation of simple correlation and regression coefficients.**

4. Computation of probability using discrete and continuous distributions.

5. Generation of random sample from discrete and continuous distributions.

6. Selection of random sample under with and without replacement for a given data set and then estimating population parameters.

7. Parametric tests based on chi square, t and F statistics.

8. Non-Parametric Tests – Sign test, Wilcoxon tests, Mann-Whitney U test, Kruskal-Wallis test.

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	M	M	M	L	M	L	M	S
CO2	S	S	M	S	S	M	M	M	M	S
CO3	S	M	M	S	S	M	M	M	M	M
CO4	S	S	S	S	S	M	M	M	M	M
CO5	S	S	S	S	S	M	M	L	M	M

*S-Strong; M-Medium; L-Low

Course Code	23DS1C3	PRINCIPLES OF DATA SCIENCE	L	T	P	C
Core/Elective/Supportive		CORE	4	0	0	4
Pre-requisite		Knowledge about Fundamentals of Data Base Management System	Syllabus Version		2022-2023	

Course Objectives:

The main objectives of this course are:

1. To provide a strong foundation for data science and its application area.
2. To understand the underlying core concepts and emerging technologies in data science.
3. To develop applied experience with data science software, programming, applications and processes.
4. To develop practical skills needed in modern analytics.
5. To give a hands-on experience with real-world data analysis.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understand the fundamental concepts of data science	K2 / K5
2	Apply Data analysis techniques for applications handling large data	K3/ K4
3	Understand various machine learning algorithms used in data science process	K5/K6
4	Visualize and present the inference using various tools	K3/K4
5	Create ethics surrounding privacy, data sharing and algorithmic decision-making	K2/K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6**- Create

Unit 1	INTRODUCTION TO DATA SCIENCE	12 hours

Definition – Basic Terminology- Data science Venn diagram- Types of Data- Structured versus Unstructured data- Quantitative versus Qualitative data- The Four Levels of Data- Five steps of Data Science- Data Science Process Overview –Data science classification-Data Science Algorithms- Business Intelligence and Data Science- Components of Data Science.

Unit 2	DATA PROCESS AND EXPLORATION	12 hours

Introduction-Prior Knowledge-Data Preparation-Modeling-Applications-Objectives of Data Exploration-Datasets- Descriptive statistics- Data Visualization: Introduction- Types of Data visualization- Technologies for visualization - Various visualization techniques - The Five Cs of Data Visualization.

Unit 3	DATA MODELLING AND ANALYTICS	10 hours

Data Science Methodology- Analytics for Data Science- Data Analytics Examples- Data Analytics Life Cycle- Data Discovery- Data preparation- Model Planning- Model Building- Operationalization.

Unit 4	FEATURE SELECTION AND FORECASTING	12 hours

Introduction-Feature Selection: Classifying feature selection methods- Anomaly Detection: Introduction- Distance and Density based outlier detection-Local Outlier Factor-Timeseries Forecasting- Decomposition-Smoothing based methods-Regression based methods-Machine Learning methods.

Unit:5	**DATA SCIENCE TOOLS AND APPLICATIONS**	**12 hours**
Introduction to Data Science Tools- SAS- APACHE FLINK -BigML- Excel- Tableau- Matplotlib- TensorFlow- Weka- Applications: Hands-on with Solving Data Problems-Introduction-Collecting and Analyzing Twitter Data- Collecting and Analyzing YouTube Data.		
Unit:6	**CONTEMPORARY ISSUES**	**2 hours**
Discussion on case study - Expert lectures - Online seminars – Webinars – Workshops		
	Total Lecture hours	**60 hours**

Text Books

1	Sanjeev J. Wagh, Manisha S. Bhende, Anuradha D. Thakare, Fundamentals of Data Science, 1st Edition, 2022
2	Daimi, Kevin, Ed. Hamid R. Arabnia, Principles of Data Science, Springer, 2020.
3	Vijay Kotu, Bala Deshpande, Data Science: Concepts and Practices, Morgan Kaufmann Publishers, Second edition, 2019
4	D J Patil, Hilary Mason, Mike Loukides, Ethics and Data Science, O' Reilly, 1st edition, 2018
5	Sinan Ozdemir, Principles of Data Science, Packt Publishing, December 2016

Reference Books

1	Jure Leskovek, Anand Rajaraman and Jeffrey Ullman, Mining of Massive Datasets. v2.1, Cambridge University Press, 2014.
2	Cielen, Davy, Arno DB Meysman, Mohamed Ali, Introducing Data Science: Big Data, Machine Learning, and more, using Python Tools, Manning Publications Co., 2016

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://onlinecourses.nptel.ac.in/noc19_cs60/preview
2	https://www.classcentral.com/course/swayam-python-for-data-science-14266
3	https://www.youtube.com/watch?v=7eMsa-ecJlA

Course Designed By: **Dr. D. Napoleon**

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	M	M	S	S	S	M
CO2	S	M	M	S	S	S	S	M	M	S
CO3	S	M	L	M	S	S	M	M	S	S
CO4	S	S	M	L	L	S	S	M	S	S
CO5	M	S	L	M	M	S	S	L	L	M

S- Strong; M-Medium; L-Low

Course Code	23DS1C4	DATABASE MANAGEMENT SYSTEMS	L	T	P	C
Core/Elective/Supportive		CORE	2	0	4	4
Pre-requisite		Knowledge on Programming Logics and Data Storage Systems	Syllabus Version	2022-2023		

Course Objectives:

The main objectives of this course are:

1. To teach the basic database concepts, applications, data models, schemas and instances.
2. To familiarize entity relationship model for a database.
3. To demonstrate the use of constraints and relational algebra operations.
4. To describe the basics of SQL and construct queries using SQL.
5. To demonstrate the basic concepts of transaction processing and concurrency control.
6. To emphasize the importance of normalization in databases.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Demonstrate the basic elements of a relational database management system.	K1/K2/K3
2	Build and manipulate relational database using Structured Query Language.	K1/K2/K3/K4
3	Apply normalization on database design to eliminate anomalies.	K2/K4/K5/K6
4	Analyze the issues in transaction processing and concurrency control.	K3/K4/K5
5	Analyze database transactions and can control them by applying ACID properties.	K3/K4/K5/K6
6	Use the functional dependency and normalization concepts to develop real-time database applications.	K4/K5/K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit 1	Introduction to Database System and ER Modeling	11 Hours

Introduction to Database Management Systems, Purpose of Database Systems, View of Data, Database Languages, Database System Structure, Data Models, Database Design and ER Model: Entity, Attributes, Relationships, Constraints, Keys.

Unit 2	Structured Query Language Basics	11 Hours

SQL Overview: Data Types and Literals, DDL, DML, DCL, TCL. Data Definitions, Basic Structure Operations, Additional Operations, Set Operations, Null Values, Aggregate Functions, Nested Sub-Queries. Modifications of Database: Deletion, Insertion and Updates.

Unit 3	Intermediate Structured Query Language	12 Hours

Joins Expressions, Views, Transactions. Relational Integrity: Domain, Referential Integrities, Enterprise Constraints. Data Types and Schemas, Authorizations, Functions and Procedures, Triggers.

Unit 4	Relational Query Languages & Database Design	12 hours

Relational Algebra, Tuple relational Calculus, Design Process, Entity Relationship Model, ER Diagram, Design Issues, Extended E-R Features, converting E-R & EER diagram into tables.		
Unit 5	**Relational Model Normalization**	**12 hours**
Relational Database Design Relational Model: Basic concepts, Attributes and Domains, CODD's Rules, Database Design: Features of Good Relational Designs, Normalization, Atomic Domains and First Normal Form, Decomposition using Functional Dependencies, Algorithms for Decomposition, 2NF, 3NF, BCNF.		
Unit 6	**Contemporary Issues**	**2 hours**
Online Courses, Webinars and Case studies		
	Total Lecture hours	**60 hours**

Text Book(s)

1	Abraham Silberchatz, Henry K.Forth, Sudharshan, Database System Concepts, 7th edition, McGraw Hill, 2020

Reference Books

1	R. Elmasri, S.B. Navathe, Fundamentals of Database Systems, Seventh Edition, Pearson Education, 2016.
2	Bipin C Desai, “An introduction to Database Systems”, Galgotia Publications, 2015.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://www.futurelearn.com/courses/introduction-to-databases-and-sql
2	https://alison.com/courses/diploma-in-databases-and-t-sql-revised/content
3	https://onlinecourses.nptel.ac.in/noc20_cs60/preview

Course Designed By: **Dr. P. B. Pankajavalli**

DATABASE MANAGEMENT SYSTEMS LAB

List of Programs

1. Creation of database for the following details:
    a. Employee details
    b. Student details
    c. Hospital management
    d. Railway reservation
    e. Hostel management

2. Perform the following: a. Viewing all databases, viewing all Tables in a Database, Creating Tables (With and Without Constraints), Inserting/Updating/Deleting Records in a Table, Saving (Commit) and Undoing (rollback).

3. Perform the following: a. Altering a Table, Dropping/Truncating/Renaming Tables, backing up / Restoring a Database.

4. For a given set of relation schemes, create tables and perform the following Simple Queries, Simple Queries with Aggregate functions, Queries with Aggregate functions (group by and having clause), Queries involving- Date Functions, String Functions, Math Functions Join Queries- Inner Join, Outer Join Subqueries- With IN clause, With EXISTS clause

5. For a given set of relation tables perform the following a. Creating Views (with and without check option), Dropping views, Selecting from a view

6. Write a PL/SQL program using FOR loop to insert ten rows into a database table.

7. Given the table EMPLOYEE (EmpNo, Name, Salary, Designation, DeptID) write a cursor to select the five highest paid employees from the table.

8. Illustrate on usage of procedures and functions.

9. Illustrate on usage of triggers.

10. Given an integer i, write a PL/SQL procedure to insert the tuple (i, 'xxx') into a given relation.

11. Draw E-R diagram and convert entities and relationships to relation table for a given scenario.

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	**S**	**S**	**L**	**M**	**S**	**L**	**L**	**L**	**M**	**S**
CO2	**S**	**S**	**M**	**M**	**S**	**L**	**L**	**M**	**M**	**S**
CO3	**S**	**S**	**S**	**S**	**S**	**L**	**L**	**M**	**S**	**S**
CO4	**S**	**S**	**S**	**S**	**S**	**L**	**L**	**M**	**S**	**S**
CO5	**S**	**S**	**S**	**S**	**S**	**L**	**M**	**M**	**S**	**S**
CO6	**S**	**S**	**S**	**S**	**S**	**M**	**M**	**S**	**S**	**S**

***S-Strong; M-Medium; L-Low**

Course Code	23DS1C5	PYTHON AND R PROGRAMMING	L	T	P	C
Core/Elective/Supportive		CORE	2	0	4	4
Pre-requisite		Basic knowledge on programming concepts and statistics	Syllabus Version		2022-2023	

Course Objectives:

The main objectives of this course are to:

1. Write simple Python programs
2. Learn the conditionals, lists and classes in python
3. Familiarize with data visualization in python
4. Write simple R programs
5. Familiarize with data visualization in R.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understand the concepts in python programming and apply for different problems	K1/K2
2	Analyze the real-life problems and solve using python programming	K2/K4
3	Apply data visualization for real time problems in python	K2/K3
4	Understand R programming and apply for different problems	K2/ K3
5	Create programs for appropriate problems using data visualization with R	K2/ K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit 1	INTRODUCTION TO PYTHON	9 hours

Introduction to Python – Features of Python – Variables, Expressions and Statements – Order of operations – String operations - Functions – Flow of execution – Parameters and arguments

Unit 2	CONDITIONALS, LISTS, CLASSES	12 hours

Conditionals and Recursion – Boolean expressions – Logical operators – Chained and Nested conditionals – Recursion - Iteration – Strings – Lists – Dictionaries – Tuples – Files – Classes and Objects

Unit 3	NUMPY, PANDAS, MATPLOTLIB	12 hours

The basics of NumPy arrays – Computation on NumPy Arrays : Universal Functions – Aggregations - Broadcasting – Comparisons, Masks and Boolean logic – Fancy Indexing – Sorting Arrays – Structured Data - Data Manipulation with Pandas – Introducing Panda Objects – Data Indexing and Selection – Operating on Data in Pandas – Handling Missing Data – Hierarchical Indexing – Working with Time Series – High Performance Pandas – Visualization with Matplotlib- Simple Line Plots – Simple Scatter Plots – Visualizing Errors - Density and Contour Plots – Histograms, Binning and Density – Three Dimensional plotting in Matplotlib – Visualization with Seaborn

Unit 4	INTRODUCTION TO R	12 hours

Basics of R – Vectors – Operations – Filtering - Matrices and Arrays – Matrix Operations - Lists – List Operations – List Components and values - Data Frames – Creation and Merging - Tables – Structures – Control Structures – Functions – Recursions.

Unit 5	DATA VISUALIZATION WITH R	13 hours

Data Visualization with ggplot2 – aesthetic mappings - geometric objects – statistical transformations – coordinate systems - Data transformation with dplyr – Exploratory data analysis – missing values – co variation – patterns and models – ggplot2 calls		
Unit 6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars - webinars		
	Total Lecture hours	**60 hours**

Text Books

1	Allen B. Downey, Think Python: How to Think Like a Computer Scientist, 2nd edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016.
2	Jake Vanderplas, Python Data Science Handbook: Essential Tools for Working with Data, 1st Edition, O'Reilly Media, 2016.
3	Norman Matloff, The Art of R Programming: A Tour of Statistical Software Design, No Starch Press, First Edition, 2011.
4	Hadley Wickham, Garett Grolemund, R for Data Science: Import, Tidy, Transform, Visualize, and Model Data, O'Reily Publications, First Edition, Feb 2017

Reference Books

1	Reema, Thareja, Python Programming: Using Problem Solving Approach, Oxford University Press, June 2017
2	Garrett Grolemund, Hands-on Programming with R: Write your own functions and simulations, O'Reilly Publisher, 2014.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://www.coursera.org/specializations/data-science-python?utm_source=gg&utm_medium=sem&utm_campaign=29-AppliedDataSciencePython-
2	https://onlinecourses.swayam2.ac.in/aic20_sp33/preview
3	https://onlinecourses.swayam2.ac.in/aic20_sp35/preview
4	https://www.coursera.org/learn/r-programming

Course Designed By: **Dr. D. Ramyachitra**

PYTHON AND R PROGRAMMING LAB

List of Programs

Python Programs

1. Swapping of values
2. Conversion of ASCII to Binary
3. Printing the first n row of Pascal's triangle.
4. Calculation of upper case and lower-case letters in a string
5. Programs using Tuple
6. Programs using conditionals
7. Programs using dictionaries
8. Programs using Boolean operators
9. Implementation of functions
10. Programs using NumPy
11. Programs using Pandas
12. Implementation of Maclaurin series
13. Programs using seaborn
14. Programs using Matplotlib

R Programs

1. Vector manipulations
2. Matrix operations
3. Array Operations
4. Operations using data frame
5. Implementation of functions
6. Drawing scatter plot, box plot, violin plot, dot plot, bar plot, line plot
7. Geometric Shapes
8. Data transformations
9. Finding missing values

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	**S**	**S**	**L**	**M**	**S**	**L**	**L**	**L**	**M**	**S**
CO2	**S**	**S**	**M**	**M**	**M**	**M**	**M**	**M**	**M**	**S**
CO3	**S**	**S**	**S**	**S**	**M**	**L**	**M**	**L**	**L**	**S**
CO4	**S**	**S**	**S**	**M**	**S**	**L**	**L**	**M**	**L**	**S**
CO5	**S**	**S**	**S**	**S**	**S**	**M**	**L**	**L**	**M**	**S**

***S-Strong; M-Medium; L-Low**


Second
Semester

Course code	23DS2C1	OPTIMIZATION TECHNIQUES USING MATLAB	L	T	P	C
Core/Elective/Supportive		CORE	2	0	4	4
Pre-requisite		Basic knowledge in functions of one variable and under graduate real analysis	Syllabus Version		2022-2023	

Course Objectives:

The main objectives of this course are to:

1. The student is expected to understand basic theoretical principles in optimization and fundamentals on MATLAB, primarily for numerical computing.
2. Define and use optimization terminology and concepts and understand how to classify an optimization problem.
3. To learn the characteristics of script files, functions and function files, two-dimensional plots and three-dimensional plots.
4. To implement basic optimization algorithms in MATLAB.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

CO1	Understand and apply constrained and unconstrained optimization theory including the necessary and sufficient optimality conditions and algorithms.	K2
CO2	Explain the fundamental knowledge of Gradient Methods, Newton's Method, Conjugate Direction Methods in order to solve various optimization problems.	K3
CO3	The ability to analyze optimization methods, including developing a model, defining an optimization problem, applying optimization methods, exploring the solution using MATLAB, and interpreting results.	K4
CO4	Apply and evaluate optimization techniques using MATLAB to find a robust design.	K5
CO5	To Create the acquired knowledge to select the most appropriate method to solve the practical applications.	K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit 1	Basics of Set-Constrained and Unconstrained Optimization, One-Dimensional Search Methods	12 hours

Introduction- Conditions for Local Minimizers. One-Dimensional Search Methods: Introduction- Golden Section Search- Fibonacci Method- Bisection Method- Newton's Method- Secant Method- Line Search in Multidimensional Optimization.

Unit 2	Gradient Methods, Newton's Method, Conjugate Direction Methods	14 hours

Gradient Methods: Introduction- The Method of Steepest Descent- Analysis of Gradient Methods. Newton's Method: Introduction- Analysis of Newton's Method. Conjugate Direction Methods: Introduction- The Conjugate Direction Algorithm- The Conjugate Gradient Algorithm.

Unit 3	Quasi-Newton Methods, Solving Linear Equations	14 hours

Quasi-Newton Methods: Introduction- The Rank One Correction Formula- The DFP Algorithm- The BFGS Algorithm. Solving Linear Equations: Least-Squares Analysis- The Recursive Least-Squares Algorithm- Solution to a Linear Equation with Minimum Norm- Kaczmarz's Algorithm

Unit 4	INTRODUCTION TO MATLAB	15 hours

Creating Arrays, Mathematical operations with Arrays, Script and function files

Unit 5	PROGRAMMING IN MATLAB	18 hours

Programming in MATLAB, 2-D and 3-D plots, Polynomials curve fitting and interpolation		
Unit 6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars - webinars		
	Total Lecture hours	**75 hours**

Text Book(s)	
1	"An Introduction to Optimization" by **Edwin K.P. Chong, Stanislaw H. Zag,** Fourth Ed., 2013 Unit I : Chapters6 & 7 : Sections:6.1-6.2, 7.1-7.6,7.8; Unit II : Chapters8,9 & 10 : Sections:8.1-8.3, 9.1-9.3, 10.1-10.3, Unit III : Chapters11 & 12 : Sections:11.1, 11.3-11.5, 12.1-12.4; "MATLAB: An Introduction with Application" by **Amos Gilat**, John Wiley & Sons, Singapore, 2004. Unit IV: Chapters 2,3,4,7; Unit V : Chapters 5,6,8,10
Reference Books	
1	**D.M. Etter, D.C. Kuncicky & H. Moore**, Introduction to MATLAB 7, Prentice Hall, New Jersey, 2004.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/courses/111/105/111105100/
2	https://nptel.ac.in/courses/111/104/111104071/
3	http://apmonitor.com/me575/
Course Designed By: **Dr. S. Saravanan & Dr. R. Rakkiyappan**	

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	S	M	M	M	S	S	M
CO2	M	M	S	M	S	M	L	M	L	M
CO3	S	S	M	M	L	M	M	M	M	M
CO4	S	S	S	M	M	L	M	M	S	S
CO5	S	M	S	S	S	M	S	S	S	S

* S- Strong; M-Medium; L-Low

Course Code	23DS2C2	MULTIVARIATE DATA ANALYSIS	L	T	P	C
Core/Elective/Supportive		CORE	2	0	4	4
Pre-requisite		Basics of Mathematics and Statistics	Syllabus Version		2022-2023	

Course Objectives

The main objectives of this course are to:

1. Inculcate the knowledge on various multivariate statistical techniques and its applications
2. know the usage of dependence and interdependence multivariate methods
3. know the statistics associated with principal component and factor analysis
4. impart the regression and classification techniques
5. learn the various clustering methods

Expected Course Outcomes

On the successful completion of the course, student will be able to:

1	Distinguish between dependence and interdependence techniques	K1-K2
2	Fit the various regression models and predict the results	K3-K6
3	Perform the dimension reduction techniques and interpret the results	K3-K6
4	Discriminate and classify the given objects by using target variable	K3-K6
5	Form the groups by using suitable clustering techniques	K3-K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit 1	Introduction to Multivariate Analysis	12 hours

Meaning of Multivariate Analysis – Multivariate Analysis in Statistical Terms – Basic concepts: Variate, Measurment Scales, Measurement Error, Multivariate Measurement, Statistical Significance and Statistical Power. Classification of Multivariate Techniques: Dependence and Independence Techniques – Applications of Multivariate Techniques.

Unit 2	Multiple Regression Analysis	12 hours

Concept of Simple and Multiple Regressions – Illustrations. Prediction using Single and Several Independent Variables – Decision Process in Multiple Regression Analysis: Objectives, Research Design, Assumptions, Estimation of Regression Model – Assessing Model Fit – Interpretation of Regression Variate using Regression Coefficients and Assessing Multicollinearity.

Unit 3	Factor Analysis	12 hours

Notion of Principal Components and Factors – Concept of Data Summarization and Data Reduction - Introduction to Principal Component Analysis and Factor Analysis – Illustrations. Decision Process in Factor Analysis: Objectives, Design, Assumptions, Deriving Factors, Interpretation of Factors, Validation of Factors – Illustrations.

Unit 4	Discriminant Analysis	12 hours

Concept of Discriminant Function – Meaning of Discriminant Analysis – Decision Process in Discriminant Analysis: Objectives, Research Design, Assumptions, Estimation of Discriminant Model, Assessing Model Fit, Interpretation.

Unit 5	Cluster Analysis	12 hours

Meaning and Conceptual Development of Cluster Analysis – Decision Process in Cluster Analysis: Objectives, Research Design, Assumptions, Deriving Clusters, Interpretation of Clusters, Validation and Profiling of Clusters – Illustrations – Basic Notion of Hierarchical and Non-hierarchical Clusters

Unit 6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – webinars		
	Total Lecture hours	**62 hours**

Reference Books	
1	Hair, J. F., Black, W. C., Babin, B. J., and Anderson, R. E. (2018). Multivariate Data Analysis, Eighth Edition, Pearson.
2	Johnson, R. A., and Wichern, D. W. (2015). Applied Multivariate Statistical Analysis, Sixth Edition, Pearson.
3	Johnson, D. E. (1998). Applied Multivariate Methods for Data Analysts, First Edition, Duxbury Press.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/courses/111105091
2	https://builtin.com/data-science/step-step-explanation-principal-component-analysis
3	https://nptel.ac.in/courses/110107080
Course Designed By: Dr. R. Vijayaraghavan / Dr. R. Muthukrishnan	

***Note*: This paper is application oriented. The derivation of the formulae and equations is outside the scope of the paper and hence, it may be avoided.**

MULTIVARIATE DATA ANALYSIS LAB

Problems relating to the following topics using R / Python programming shall form the basis for setting the question paper.

1. Computation of Mean vector and covariance matrix for multivariate data set
2. Generation of multivariate data using multivariate normal distribution
3. Fitting of linear, quadratic, exponential and logistic models
4. Principal Component analysis and factor analysis
5. Linear and quadratic discriminant analysis with classification of two and three groups.
6. Cluster analysis with hierarchical clustering (single linkage, average linkage, Wards method) and non-hierarchical clustering (k-means)

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	S	S	S	M	L	L	M	S
CO2	S	S	M	M	M	S	M	M	M	M
CO3	S	S	S	M	M	M	M	M	L	S
CO4	S	S	S	S	S	S	M	M	L	S
CO5	S	S	S	M	M	M	M	M	L	S

*S-Strong; M-Medium; L-Low

Course Code	23DS2C3	MACHINE LEARNING TECHNIQUES	L	T	P	C
Core/Elective/Supportive		CORE	2	0	4	4
Pre-requisite		Basic knowledge on mathematics, statistics and good analytical skills	Syllabus Version		2022-2023	

Course Objectives:

The main objectives of this course are to:

1. Introduce the concepts of machine learning
2. Understand supervised and unsupervised learning algorithms
3. Gain knowledge on evaluation of the performance of the machine learning techniques
4. Learn about the advanced learning techniques

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Analyze and apply the machine learning concepts for different problems	K3/K4
2	Understand and implement the supervised learning algorithms	K1/K2
3	Apply the clustering algorithms for various problems	K3
4	Evaluate and test the performance of the learning algorithms	K5
5	Design and create a learning model for real time applications	K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit 1	INTRODUCTION	9 hours

Introduction – Definition of learning systems – Goals and applications of Machine Learning – Types of Machine Learning – Machine Learning process – Hypothesis space and Version space

Unit 2	SUPERVISED LEARNING	12 hours

Linear models for Regression – Linear models for Classification – Decision Tree Learning – Bayesian Learning – Naïve Bayes – Ensemble Methods – Bagging – Boosting – Support Vector Machines.

Unit 3	EVALUATION	11 hours

Performance Evaluation metrics – ROC Curves – Validation methods – Bias-variance decomposition – Model complexity

Unit 4	UNSUPERVISED LEARNING	12 hours

Clustering – K-means – K-mode- K-median – Hierarchical clustering – DBSCAN – Principal Component Analysis – Independent Component Analysis

Unit 5	ADVANCED LEARNING	14 hours

Sampling – Basic sampling methods – Monte Carlo – Gibbs Sampling – Computational Learning theory – Reinforcement learning – Markov Decision Processes.

Unit:6	Contemporary Issues	2 hours

Expert lectures, online seminars - webinars

	Total Lecture hours	**60 hours**

Text Books

1	Tom Mitchell, Machine Learning, McGraw-Hill, UK, 2017
2	Ethem Alpaydin, Introduction to Machine Learning, MIT Press, Third Edition, 2014.

Reference Books

1	Stephen Marsland, Machine Learning – An Algorithmic Perspective, Chapman and Hall, CRC Press, Second Edition, 2014.
2	Shalev-Shwartz, Shai, Shai Ben-David, Understanding Machine Learning: From theory to algorithms, Cambridge University Press, 2014.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://onlinecourses.nptel.ac.in/noc20_cs29/preview
2	https://www.coursera.org/learn/machine-learning

Course Designed By: **Dr. D. Ramyachitra**

MACHINE LEARNING TECHNIQUES - LAB

List or Programs

1. Implementation of k-nearest neighbors' classification
2. Extraction of data from database
3. Implementation of linear regression
4. Implementation of Naïve bayes theorem to classify the English text
5. Implementation of ID3 –Algorithm
6. Implementation of Support Vector Machine algorithm
7. Implementation of k – means algorithm
8. Implementation of hierarchical clustering

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	L	M	S	L	L	L	M	S
CO2	S	S	M	M	S	M	L	M	L	S
CO3	S	S	S	S	M	M	M	L	L	S
CO4	S	S	S	M	S	L	L	M	M	S
CO5	S	S	S	S	S	L	M	L	M	S

***S-Strong; M-Medium; L-Low**

Course Code	23DS2C4	DATA MINING	L	T	P	C
Core/Elective/Supportive		CORE	4	0	0	4
Pre-requisite		Fundamentals of Database management	Syllabus Version		2022-2023	

Course Objectives:

The main objectives of this course are:

1. To understand the concepts of data mining, issues and applications.
2. To preprocess and analyze data, to select appropriate models and algorithms for respective applications and to develop research interest towards advances in data mining.
3. To learn various data mining techniques like classification, clustering, association rule mining.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understand the fundamental concepts of data mining and preprocessing	K1/K2
2	Understand the basic concepts of Association Rule Mining. Analyze and evaluate the performance of Association Rule Mining algorithms	K2/K4/K5
3	Understand the classification concepts and the working principles of different algorithms	K2/K3
4	Apply the clustering techniques to carry out simple data mining tasks and analyze their performance	K3/K4
5	Focus towards research and innovation	K4/K5/K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit 1	INTRODUCTION AND DATA PREPROCESSING	12 hours

Data Mining – Kinds of data to be mined – Kinds of patterns to be mined – Technologies – Targeted Applications - Major Issues in Data Mining – Data Objects and Attribute Types – Measuring Data similarity and dissimilarity - Data Cleaning –Data Integration - Data Reduction – Data Transformation – Data Discretization.

Unit 2	MINING FREQUENT PATTERNS AND ADVANCED PATTERN MINING	10 hours

Basic Concepts – Frequent Itemset Mining Methods – Pattern Evaluation Methods – Pattern Mining in Multilevel, Multidimensional space – Constraint-Based Frequent Pattern Mining – Mining Compressed or Approximate Patterns.

Unit 3	CLASSIFICATION TECHNIQUES	12 hours

Basic Concepts – Decision Tree Induction – Bayes Classification Methods – Rule-Based Classification – Model Evaluation and Selection – Techniques to Improve Classification Accuracy

Unit 4	CLUSTERING TECHNIQUES	12 hours

Cluster Analysis – Partitioning Methods - Hierarchical Methods – Density-Based Methods

Unit 5	DATA MINING TRENDS AND RESEARCH FRONTIERS	12 hours

Mining Complex Data Types - Other Methodologies - Data Mining Applications - Data Mining and Society – Data Mining Trends

Unit 6	**Contemporary Issues**	**2 hours**
Discussion on case study - Expert lectures - Online seminars – Webinars – Workshops		
	Total Lecture hours	**60 hours**

Text Books	
1	Jiawei Han, Micheline Kamber and Jian Pie, Data Mining Concept and Techniques, Morgan and Kaufmann Publisher, Third Edition, 2012
2	Arun K Pujari, Data Mining Techniques, Second Edition, Universities Press India Pvt. Ltd. 2010.
Reference Books	
1	Daniel T. Larose and Chantal D. Larose, Data Mining and Predictive Analytics, Wiley Series on Methods and Applications in Data Mining, Wiley Publications
2	Margaret H. Dunham, Data Mining Introductory and Advanced Topics, Pearson Education 2004.
3	Mark A. Hall, Ian H. Witten, Eibe Frank (2011). Data Mining: Practical Machine Learning Tools and Techniques, 3/e, Morgan Kaufmann Publishers, San Francisco
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://onlinecourses.nptel.ac.in/noc21_cs06/preview
2	https://www.coursera.org/specializations/data-mining
3	https://www.mygreatlearning.com/academy/learn-for-free/courses/data-mining1
4	https://www.javatpoint.com/data-mining
5	https://www.tutorialspoint.com/data_mining/index.htm
Course Designed By: **Dr. S. Vijayarani**	

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	**S**	**M**	**S**	**L**	**L**	**M**	**S**	**L**	**M**	**L**
CO2	**S**	**M**	**S**	**L**	**M**	**M**	**S**	**M**	**M**	**S**
CO3	**S**	**L**	**S**	**M**	**M**	**M**	**S**	**S**	**M**	**S**
CO4	**S**	**M**	**S**	**M**	**M**	**S**	**S**	**M**	**L**	**M**
CO5	**S**	**L**	**S**	**M**	**S**	**S**	**S**	**M**	**S**	**S**

S- Strong; M-Medium; L-Low

Course Code	23DS2C5	IOT ANALYTICS	L	T	P	C
Core/Elective/Supportive		CORE	4	0	0	4
Pre-requisite		Knowledge on basic terminologies and concepts in Data Science, In depth knowledge on IoT	Syllabus Version		2022-2023	

Course Objectives:

The main objectives of this course are:

1. To understand IoT analytics, challenges, and connectivity protocols.
2. To introduce IoT cloud and big data integration techniques and services.
3. To inculcate knowledge on creating cloud analytics environment.
4. To explore and visualize of IoT data.
5. To familiarize with IoT analytics applications.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understand the concepts and techniques of IoT Data Analytics Lifecycle and Machine Learning Application in IoT.	K1/K2
2	Develop cognitive IoT solutions, leveraging artificial intelligence and data science.	K3/K4/K6
3	Examine concepts of cloud based IoT, big data and IoT in various domains	K2/K4/K5/K6
4	Propose new strategies for organizations to optimize cost benefits using IoT data.	K3/K4/K5/K6
5	Explore end-to-end data science industry use cases using the data analytics lifecycle.	K2/K3/K4
6	Expose the importance of Data Analytics in IoT with respect to multiple applications	K4/K5/K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit 1	Introduction to Internet of Things and Analytics	12 hours

Introduction to Internet of Things (IoT): Concepts and Definition of IoT – IoT Devices - IoT Networking Connectivity Protocols – IoT Data Messaging Protocols – MQTT, CoAP. IoT Analytics: Data vs big data- Challenges of IoT Analytics Applications - IoT Analytics Lifecycle and Techniques.

Unit 2	IoT Cloud and Big Data Integration	12 hours

IoT Cloud and Big Data Integration: Cloud based IoT platform – Data Analytics for IoT – Data Collection – WAZIUP software Platform – Ikaas Software Platform - Elastic analytics concepts – designing for scale – Cloud security and analytics – AWS overview - AWS key services for IoT analytics.

Unit 3	Strategies and Techniques in Data Collection	12 hours

Strategies and Techniques in Data collection: Designing Data Processing for Analytics – Applying Big Data to Storage – Apache Spark for IoT Data Processing - Solving Industry Specific Problems.

Unit 4	Geospatial Analytics to IoT Data	10 hours

Geospatial Analytics to IoT Data: Basics – Vector and Raster Based Methods – Processing Geospatial Data. Data Science for IoT Analytics – Machine Learning Basic – Forecasting IoT data using ARIMA – Deep learning with IoT data.		
Unit 5	**Applications & Case Studies**	**12 hours**
Applications & Case Studies: Data Analysis in Smart Building – Internet of Things Analytics for Smart Cities – IoT Analytics: From Data Collection to Deployment and Operationalization.		
Unit 6	**Contemporary Issues**	**2 Hours**
Online courses, Webinars and Real time scenarios in IoT Analytics		
	Total Lecture hours	**60 hours**

Text Book

1	Andrew Minteer, Analytics for the Internet of things, Packt publishing, 2017.
2	John Soldatos, Building Blocks for IoT Analytics, River Publishers, 2016.

Reference Books

1	Rajkumar Buyya, Amir Vahid Dastjerdi, Internet of Things: Principles and Paradigms, Elsevier, 2016.
2	R. Chandrasekaran, Essentials of Cloud computing, 2nd Edition, Chapman and Hall/CRC, 2015.
3	Amita Kapoor, Hands on Artificial intelligence for IoT, 1st Edition, Packt Publishing, 2019.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

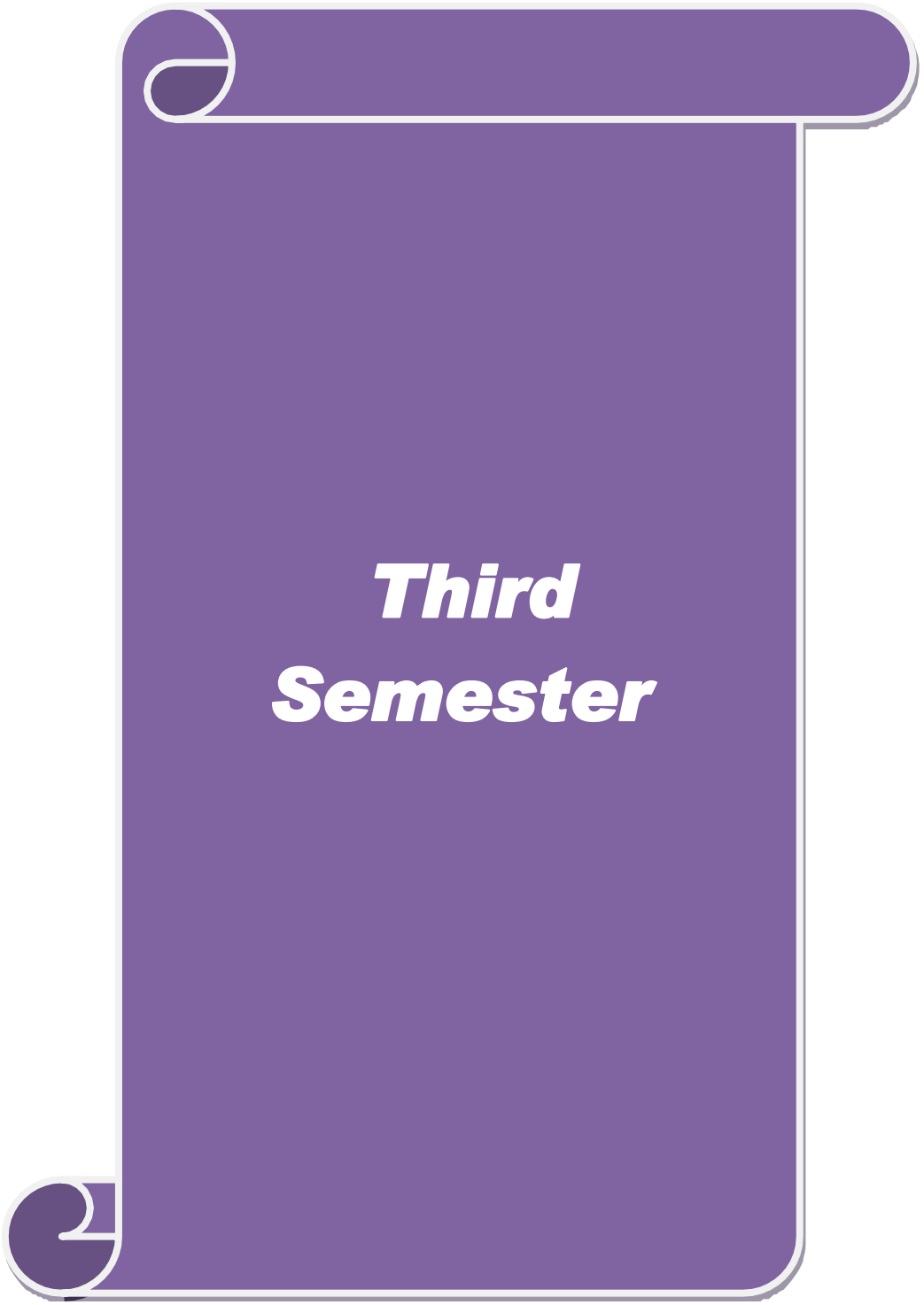
1	https://www.udemy.com/course/data-analytics-in-internet-of-things-iot/
2	https://www.coursera.org/lecture/aws-iot-developing-and-deploying-an-internet-of-things/iot-analytics-part-1-p5qoe

Course Designed By: **Dr. P. B. Pankajavalli**

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	S	M	M	S	M	S
CO2	S	S	S	S	S	M	S	M	S	S
CO3	S	S	S	S	S	M	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S
CO6	S	S	S	S	S	M	M	L	S	S

***S-Strong; M-Medium; L-Low**


Third
Semester

Course Code	23DS3C1	BIG DATA ANALYTICS	L	T	P	C
Core/Elective/Supportive		CORE	2	0	4	4
Pre-requisite		Basics of Big Data, Technologies and Applications	Syllabus Version		2022-2023	

Course Objectives:

The main objectives of this course are:

1. To provide in depth knowledge about the basic concepts of Big Data, characteristics and industry examples.
2. To discuss the Hadoop framework, HDFS and MapReduce.
3. To inculcate HBase, Cassandra, HiveQL, Pig, and Neo4j data models.
4. To understand the need and application of Map Reduce.
5. To know about the research that requires the integration of large amounts of data.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understand about basics of Big Data, Technologies and Applications in various domains.	K2
2	Understand the foundations of Hadoop and Hadoop Distributed File System. Design of HDFS and file-based data structures.	K2/K3/ K4
3	Analyze the working of Map Reduce and YARN for job scheduling.	K2/K3/K4
4	Evaluate the need and fundamentals of HBase. Apply the Cassandra data model for different applications. Understand the basic commands in HiveQL, Pig and Pig Latin.	K2/K3/K4
5	Analyze the basic concepts and need for Graph databases, create databases and retrieve records using Neo4j. Understand the data visualization and its need.	K2/K3/K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit 1	Introduction to Big Data	10 hours

Introduction: What is big data – why big data – convergence of key trends - unstructured data – industry examples of big data – Web analytics - big data and marketing – fraud and big data - risk and big data – credit risk management – big data and algorithmic trading - big data and healthcare – big data in medicine – advertising and big data – big data technologies - cloud and big data– mobile business intelligence – crowd sourcing analytics.

Unit 2	Hadoop	12 hours

History of Hadoop - The Hadoop Distributed File System – components of Hadoop - Analyzing the Data with Hadoop - Design of HDFS – HDFS concepts - Hadoop I/O – data integrity – compression – serialization – Avro – file-based data structures.

Unit 3	MapReduce	15 hours

MapReduce: MapReduce workflows – unit tests with MRUnit – test data and local tests – anatomy of MapReduce job run – classic Map-reduce – YARN – failures in classic Map-reduce and YARN – job scheduling – shuffle and sort – task execution –MapReduce types – input formats – output formats.

Unit 4	Hadoop Eco System	10 hours

HBase – data model and implementations – HBase clients – HBase examples. Cassandra – Cassandra data model –Cassandra examples – Cassandra clients –Hadoop integration. Pig – Grunt – pig data model – Pig Latin – developing and testing Pig Latin scripts. Hive – data types and file formats – HiveQL data definition – HiveQL data manipulation –HiveQL queries-case study.		
Unit 5	**Graph Databases**	**11 hours**
Introduction - Neo4J - Key concept and characteristics -Modeling data for neo4j - Importing data into neo4j - visualizations - neo4j - Cypher Query Language –data visualization.		
Unit 6	**Contemporary Issues**	**2 hours**
Discussion on case study - Expert lectures - Online seminars – Webinars – Workshops		
	Total Lecture hours	**60 hours**

Text Books

1	Daimi, Kevin, Hamid R. Arabnia, Principles of Data Science. Ed. Springer, 2020.
2	SinanOzdemir, Principles of Data Science: Mathematical Techniques and Theory to Succeed in Data-Driven Industries, Packt Publishing Limited, 2016
3	Rik Van Bruggen, Learning Neo4j, Second Edition, PacktPubishers, 2014.
4	Michael Minelli, Michelle Chambers, Ambiga Dhiraj, Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses, Wiley, 2013.
5	Tom White, “Hadoop: The Definitive Guide”, Fourth Edition, O′Reilly Publishers, 2012.

Reference Books

1	Andreas Francois Vermeulen, Ankurgupta, Cindy Gross, David Kjerrumgaard and Scott Shaw, Practical Hive: A Guide to Hadoop’s Data Warehouse System, Apress Media publishers, 2016
2	Eric Lubow and Russell Baradberry, Practical Cassandra: A Developer’s Approach, Addison Wesley publishers, 2014.
3	EMC Education Services, Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data, Wiley publishers, 2015.
4	Bart Baesens, Analytics in a Big Data World: The Essential Guide to Data Science and its Applications, Wiley Publishers, 2015.
5	Kim H. Pries and Robert Dunnigan, Big Data Analytics: A Practical Guide for Managers, CRC Press, 2015.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	TEL, Websites etc.] 1 https://nptel.ac.in/courses/106/104/106104189/
2	https://www.edureka.co/blog/big-data-tutorial
3	https://www.coursera.org/learn/big-data-introduction
4	https://nptel.ac.in/courses/106107220

Course Designed By: **Dr. D. Napoleon**

BIG DATA ANALYTICS LAB

List of Programs

1. Installing Hadoop; Understanding different Hadoop modes. Startup scripts, Configuration files.
2. Hadoop Implementation of file management tasks, such as adding files and directories, retrieving files and deleting files.
3. Run a basic Word Count Map Reduce program to understand Map Reduce Paradigm.
4. Hive Installation and Table Operations.
5. Hive Databases, Tables, Views, Functions and Indexes.
6. Neo4j - Crud operations using datasets; Find a relationship between datasets; Construct a graph; String and aggregation operations.
7. Pig Latin scripts - sort, group, join, project, and filter operations.
8. Installation of Cassandra and perform key space and table operation; Crud operations
9. Installation of Hbase and simple operations.

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	**S**	**M**	**S**	**S**	**M**	**L**	**M**	**L**	**M**	**L**
CO2	**S**	**M**	**M**	**S**	**S**	**M**	**S**	**L**	**M**	**M**
CO3	**S**	**L**	**S**	**M**	**S**	**L**	**L**	**M**	**S**	**M**
CO4	**S**	**M**	**S**	**M**	**M**	**M**	**S**	**S**	**M**	**M**
CO5	**S**	**L**	**S**	**M**	**M**	**S**	**M**	**S**	**S**	**M**

S- Strong; M-Medium; L-Low

Course Code	23DS3C2	DEEP LEARNING TECHNIQUES	L	T	P	C
Core/Elective/Supportive		CORE	2	0	4	4
Pre-requisite		Basic knowledge on mathematics, statistics and machine learning concepts	Syllabus Version		2022-2023	

Course Objectives:

The main objectives of this course are to:

1. Understand the principles of neural networks
2. Understand the basic concepts of deep learning
3. Understand and implement the architectures of deep learning.
4. Familiarize with the applications of deep learning

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understand the deep learning concepts and apply for different problems	K2/K3
2	Design and apply Convolutional and Recurrent Neural Networks	K1/K3
3	Understand and evaluate different deep learning architectures	K2/K5
4	Design and create deep learning applications	K6
5	Analyze the role of deep learning models in image processing	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit 1	BASICS OF NEURAL NETWORKS	9 hours

Basics of neural networks - Basic concept of Neurons – Perceptron Algorithm – Feed Forward and Back Propagation Networks.

Unit 2	INTRODUCTION TO DEEP LEARNING	12 hours

Introduction to deep learning - Feed Forward Neural Networks – Gradient Descent – Back Propagation Algorithm – Vanishing Gradient problem – Mitigation – RelU Heuristics for Avoiding Bad Local Minima – Heuristics for Faster Training – Nestors Accelerated Gradient Descent – Regularization –

Unit 3	CONVOLUTIONAL & RECURRENT NEURAL NETWORK	11 hours

Convolutional neural networks - Kernel Filters – Multiple Filters - CNN Architectures – Convolution – Pooling Layers – Transfer Learning – Image Classification using Transfer Learning - Introduction to RNNs, Unfolded RNNs, Seq2Seq RNNs, LSTM, RNN applications

Unit 4	DEEP LEARNING ARCHITECTURES	12 hours

LSTM, GRU, Encoder/Decoder Architectures – Autoencoders – Standard- Sparse – Denoising – Contractive- Variational Autoencoders – Adversarial Generative Networks – Autoencoder and DBM

Unit 5	APPLICATIONS OF DEEP LEARNING	14 hours

Applications of deep learning - Image Segmentation – Object Detection – Automatic Image Captioning – Image generation with Generative Adversarial Networks – Video to Text with LSTM Models – Attention Models for Computer Vision		
Unit 6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars - webinars		
	Total Lecture hours	**60 hours**

Text Book(s)

1	Ian Good Fellow, Yoshua Bengio, Aaron Courville, “Deep Learning”, MIT Press, 2017.
2	Goodfellow, I., Bengio,Y., and Courville, A., Deep Learning, MIT Press, 2016.

Reference Books

1	Francois Chollet, “Deep Learning with Python”, Manning Publications, 2018.
2	Phil Kim, “Matlab Deep Learning: With Machine Learning, Neural Networks and Artificial Intelligence”, Apress , 2017.
3	Ragav Venkatesan, Baoxin Li, “Convolutional Neural Networks in Visual Computing”, CRC Press, 2018.
4	Navin Kumar Manaswi, “Deep Learning with Applications Using Python”, Apress, 2018.
5	Joshua F. Wiley, “R Deep Learning Essentials”, Packt Publications, 2016.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://onlinecourses.nptel.ac.in/noc20_cs11/preview
2	https://www.coursera.org/specializations/deep-learning

Course Designed By: **Dr.D.RAMYACHITRA**

DEEP LEARNING TECHNIQUES LAB

List of Programs

1. Implementation of feed forward neural network
2. Implementation of convolutional neural network
3. Image classification
4. Image segmentation
5. Time series forecasting
6. Text classification and machine translation
7. Text generation
8. Image generation

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	L	M	S	L	L	L	M	S
CO2	S	S	M	M	S	L	L	M	L	M
CO3	S	M	S	S	M	M	M	L	M	S
CO4	S	S	S	S	S	L	L	M	M	S
CO5	S	S	S	S	M	L	M	L	S	S

*S-Strong; M-Medium; L-Low

Course code	23DS3C3	DATA PRIVACY AND SECURITY	L	T	P	C
Core/Elective/Supportive		CORE	4	0	0	4
Pre-requisite		Basic knowledge about databases, data structures and networking concepts	Syllabus Version		2022-2023	

Course Objectives:

The main objectives of this course are:

1. To understand the importance of data privacy and security.
2. To learn about the privacy preservation methods for protecting various kinds of data
3. To study the significant privacy regulations.
4. To implement security policies and security controls for information and system protection

Expected Course Outcomes:

1	Understand the need for data sharing. Analyze the necessity of different privacy-preserving methods	K1 / K4
2	Apply the privacy-preserving methods for various types of data and evaluate their performance	K2/K3/K5
3	Understand the privacy regulations formed by the different countries	K2 / K3
4	Remember and evaluate the security policies. Identify the system vulnerabilities	K1/K5/K6
5	Assess the security using tools. Apply the information security policies and standards for device management	K5/K4/K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit 1	Introduction	10 hours

Data Privacy and its Importance - Need for Sharing Data - Methods of Protecting Data - Importance of Balancing Data Privacy and Utility – Introduction to Anonymization Design Principles - Nature of Data in the Enterprise Static Data Anonymization on Multidimensional Data: Introduction - Classification of Privacy Preserving Methods - Classification of Data in a Multidimensional Data Set - Group-Based Anonymization

Unit 2	Static Data Anonymization on Complex Data Structures	12 hours

Introduction - Privacy Preserving Graph Data - Privacy Preserving Time Series Data - Privacy Preservation of Longitudinal Data - Privacy Preservation of Transaction Data - Static Data Anonymization: Threats to Anonymized Data - Threats to Data Structures - Threats by Anonymization Techniques

Unit 3	Privacy Regulations	12 hours

Introduction - UK Data Protection Act 1998. - Federal Act of Data Protection of Switzerland 1992 - Payment Card Industry Data Security Standard (PCI DSS) - The Health Insurance Portability and Accountability Act of 1996 (HIPAA): Effects of Protection - Anonymization Considerations - Anonymization Design for HIPAA - Explicit Identifiers - Quasi-Identifiers - Sensitive Data. - Anonymization Design Checklist

Unit 4	**Data Security**	**12 hours**
Securing Unstructured Data: Structured Data vs. Unstructured Data – At Rest, in Transit and in Use – Approaches to secure Unstructured Data – Newer Approaches to Secure Unstructured Data. Information Rights Management: Overview – IRM Technology Details – Getting Started with IRM. Encryption: History of Encryption – Symmetric Key Cryptography - Public Key Cryptography		
Unit 5	**Storage and Database Security**	**12 hours**
Storage Security: Evolution – Modern Storage Security – Risk Remediation – Best Practices. Database Security: General Concepts – Database Security Layers – Database-Level Security – Database Backup and Recovery – Database Auditing and Monitoring		
Unit 6	**Contemporary Issues**	**2 hours**
Discussion on case study - Expert lectures - Online seminars − Webinars − Workshops		
	Total Lecture hours	**60 hours**

Text Books	
1	Venkataramanan, Nataraj, and Ashwin Shriram. Data Privacy: Principles and Practice. CRC Press, 2017.
2	Rhodes-Ousley, Mark. Information Security: The Complete Reference, Second Edition, And Information Security Management: Concepts and Practice. New York, McGraw-Hill, 2013.
Reference Books	
1	David Salomon, Data Privacy and Security, Springer, 2003
2	Andrew Vladimirov Michajlowski, Konstantin, Andrew A. Vladimirov, and Konstantin V. Gavrilenko. Assessing Information Security: Strategies, Tactics, Logic and Framework. IT Governance Ltd, 2010
3	William Stallings, Lawrie Brown, Computer Security: Principles and Practice, 3rd edition, Pearson, 2014.
4	Serge Gutwirth, Ronald Leenes, Paul De Hert, Data Protection on the Move – Current Developments in ICT and Privacy/Data Protection, Springer, 2016
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://onlinecourses.nptel.ac.in/noc22_cs37/preview
2	https://onlinecourses.nptel.ac.in/noc21_cs28/preview
3	https://www.coursera.org/learn/privacy-law-data-protection
4	https://www.coursera.org/learn/data-security-privacy
5	https://www.edx.org/learn/data-privacy
6	https://www.udemy.com/course/data-security-and-privacy-training/
Course Designed By: **Dr. S. Vijayarani**	

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	**S**	**S**	**M**	**M**	**M**	**S**	**S**	**L**	**M**	**L**
CO2	**S**	**M**	**S**	**S**	**M**	**S**	**L**	**M**	**S**	**S**
CO3	**S**	**S**	**M**	**S**	**S**	**M**	**M**	**S**	**L**	**M**
CO4	**S**	**M**	**S**	**M**	**L**	**S**	**L**	**M**	**S**	**S**
CO5	**S**	**M**	**L**	**S**	**S**	**M**	**S**	**S**	**M**	**M**

S- Strong; M-Medium; L-Low

Elective Courses

Course code	23DS1E1	DESIGN OF ALGORITHMS	L	T	P	C
Core/Elective/Supportive		ELECTIVE	4	0	0	4
Pre-requisite		Basic knowledge of programming, data structures and mathematics	Syllabus Version		2022-2023	

Course Objectives:

The main objectives of this course are:

1. To understand and apply the algorithm analysis techniques.
2. To analyze the efficiency of alternative algorithmic solutions for the same problem.
3. To implement different algorithm design techniques.
4. To identify the limitations of Algorithmic power.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understand the algorithm basics and the procedure to analyze the efficiency of the algorithms.	K1/K2/K4
2	Understand the Divide-and-conquer method and apply the algorithms for solving problems. Analyze the efficiency of the different methods	K2/K3/K4
3	Analyze the Greedy algorithms and evaluate their performance	K4 / K5
4	Apply, Analyze and Evaluate the Dynamic Programming algorithms for handling various real time problems	K4/K5/K6
5	Analyze and evaluate the efficiency of Backtracking algorithms	K4 / K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	Introduction	12 hours

Introduction: Definition, Structure and Properties of algorithms –Development of an algorithm – Data Structures and algorithms –Data Structure definition and classification. Analysis of algorithms: Efficiency of algorithms –Apriori analysis –Asymptotic notations –Time complexity of an algorithm using O notation –Polynomial Vs Exponential algorithms –Average, Best and Worst-case complexities –Analyzing recursive programs.

Unit:2	Divide and Conquer	10 hours

Divide and Conquer: General Method, Binary Search, Finding the Maximum and Minimum, Merge Sort, Quick Sort.

Unit:3	Greedy Method	12 hours

Greedy Method: General Method, Knapsack Problem, Minimum Cost Spanning Tree, Single Source Shortest Paths.

Unit:4	Dynamic Programming	12 hours

Dynamic Programming: General Method –Multistage Graphs –All Pair Shortest Path –Traveling Salesman Problem – Optimal Binary Search Trees.

Unit:5	Back Tracking	12 hours

Backtracking: General Method –8-Queens Problem –Sum of Subsets – Hamiltonian Cycles. Branch

and Bound: The Method –0/1 Knapsack Problem –Traveling Salesperson Problem		
Unit:6	**Contemporary Issues**	**2 hours**
Discussion on case study - Expert lectures - Online seminars − Webinars − Workshops		
	Total Lecture hours	**60 hours**

Text Books	
1	E Horowitz, S Sahani S Rajasekaran, "Fundamentals of Computer Algorithms",2E, Universities Press
2	GAV Pai, Data Structures and Algorithms Concepts, Techniques and Applications, Tata McGraw Hill, 2008
Reference Books	
1	Robert Sedgewick, Phillipe Flajolet, "An Introduction to the Analysis of Algorithms", Second Edition, Addison- Wesley Professional, 2013
2	Thomas H. Cormen, Charles E. Leiserson, R.L. Rivest, Algorithms, Prentice Hall of India Publications, New-Delhi
3	Sara Baase and Allen Van Gelder, Computer Algorithms: Introduction to Design and Analysis, Pearson education (Singapore) Pte. Ltd, New Delhi
4	Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, The Design and Analysis of Computer Algorithms, Pearson Education (Singapore) Pte. Ltd New Delhi.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/courses/106106131
2	https://www.edx.org/course/algorithm-design-and-analysis
3	https://www.udemy.com/course/design-and-analysis-of-algorithm-/
4	https://www.coursera.org/specializations/algorithms
5	https://ocw.mit.edu/courses/6-046j-design-and-analysis-of-algorithms-spring-2015/
Course Designed By: **Dr. S. Vijayarani**	

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	M	M	S	L	L	M	L
CO2	S	S	S	S	M	L	L	M	S	S
CO3	M	S	S	S	S	M	M	M	L	M
CO4	S	M	S	M	L	L	L	M	S	S
CO5	S	M	L	S	S	M	S	S	M	M

S- Strong; M-Medium; L-Low

Course Code	23DS1E2	ARTIFICIAL INTELLIGENCE	L	T	P	C
Core/Elective/Supportive		ELECTIVE	4	0	0	4
Pre-Requisite		Basic knowledge on understanding and analysing the problems strategies.	Syllabus Version		2023-2024	

Course Objective:

The main objectives of this course are:

1. To inculcate the knowledge on approaching and solving the problems using intelligent approach.
2. To provide depth understanding on knowledge representation, inference and learning.
3. To understand the control strategies in planning and production system.
4. To motivate the students to develop models for AI with Expert systems for real world problems.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understand the AI foundations, problem-solving strategies using agents and search strategies	K1/K2
2	Present the search strategies for complex environment, game playing and different knowledge representations.	K1/K2
3	Provide knowledge on knowledge reasoning and planning, handling uncertainty and knowledge inference methods.	K2/K4
4	Understand the production control strategies and algorithms for planning.	K2/K3/K4
5	Design and Implement expert systems by building the knowledge base and the inferencing engine.	K3/K4/K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit 1	PROBLEM SOLVING	10 hours

Introduction to AI- Foundations of AI – Risks and benefits of AI - Agents and Environments – Structure of Agents - Uninformed Search Strategies- Informed Search Strategies- Heuristic functions - Local Search Algorithm.

Unit 2	SEARCH IN COMPLEX ENVIRONMENT, GAMES AND KNOWLEDGE REPRESENTATION	12 hours

Introduction to Game Playing-Alpha Beta Pruning- Constraint Satisfaction Problems - Knowledge Representation using First order logic- Knowledge Engineering in First Order Logic-Proportional vs First Order Logic.

Unit 3	KNOWLEDGE REASONING AND PLANNING	13 hours

Inference- Forward and Backward Chaining-Unification-Uncertainty-Inference in Bayesian Network – Inference in Temporal models – Hidden Markov Models – Kalman Filters – Dynamic Bayesian Networks – Combining Beliefs and desires under uncertainty – Decision Networks.

Unit 4	PRODUCTION SYSTEM AND PLANNING	13 hours

Introduction to Production system-control strategies-Rete Algorithm-Planning-STRIPS- Planning with state space search-Partial Order Planning-Planning Graphs-Planning, acting in the real world.

Unit 5	**EXPERT SYSTEM**	**12 hours**
Expert System- Architecture and Roles of Expert System-Typical Expert System-MYCIN- XOON-DART Case Study-Construction of simple reflex agent with sensor and actuator using Arduino.		
Unit 6	**Contemporary Issues**	**2 hours**
Discussion on case study - Expert lectures - Online seminars − Webinars − Workshops		
	Total Lectures	**62 hours**

Text Books	
1	Stuart Russell, Peter Norvig, "Artificial Intelligence – A Modern Approach", 3rd Edition, Pearson Education / Prentice Hall of India, 2010.
2	Joseph C. Giarratano, Gary D. Riley," Expert Systems: Principles and Programming", 4th Edition, 2015.
Reference Books	
1	Nils J. Nilsson, "Artificial Intelligence: A new Synthesis", Harcourt Asia Pvt. Ltd., 2000.
2	Kevin Night and Elaine Rich, Nair B., "Artificial Intelligence (SIE)", Mc Graw Hill-2008.
3	W. Patterson, 'Introduction to Artificial Intelligence and Expert Systems', Prentice Hall of India, 2007
4	Prateek Joshi, "Artificial Intelligence with Python", Packt Publishing, 2017.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://onlinecourses.swayam2.ac.in/cec21_cs08/preview
2	https://www.tutorialspoint.com/artificial_intelligence/index.htm
3	https://www.coursera.org/learn/introduction-to-ai
4	https://www.udacity.com/course/intro-to-artificial-intelligence--cs271
Course Designed By: **Dr.R.Porkodi**	

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	L	M	M	L	L	L	M	M
CO2	S	S	M	M	M	M	M	M	M	M
CO3	S	S	M	M	M	M	M	M	M	L
CO4	S	S	M	M	M	M	L	L	M	L
CO5	S	S	M	M	M	L	L	M	M	L

Course Code	23DS1E3	BUSINESS INTELLIGENCE	L	T	P	C
Core/Elective/Supportive		Elective	4	0	0	4
Pre-Requisite		No pre-requisite	Syllabus Version		2023-2024	

Course Objective:

The main objectives of this course are:

1. To gain knowledge on business intelligence system, life cycle and techniques used in it.
2. To become familiar with the knowledge delivery and modeling aspects.
3. To learn how to use and apply machine learning models to solve the business problems.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understand the concepts of Business Intelligence cycle to take the correct decision at right time.	K1/K2/K4
2	Demonstrate various Business knowledge representations and reporting features.	K2/K3/K4
3	Identification of good operating practices in business environments.	K3/K4
4	Demonstrates the Business Intelligence models in logistics and production domain.	K3/K4/K5
5	Communicate technologies going to rule the future of Business Intelligence.	K3/K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	INTRODUCTION	10 hours

Business Intelligence: Effective and timely decisions – Data, information and knowledge – Role of mathematical models – Business intelligence architectures: Cycle of a business intelligence analysis – Enabling factors in business intelligence projects – Development of a business intelligence system – Ethics and business intelligence.

Unit:2	BUSINESS INTELLIGENCE KNOWLEDGE DELIVERY	13 hours

Knowledge Delivery: The business intelligence user types, Standard reports, Interactive Analysis and Adhoc Querying, Parameterized Reports and Self-Service Reporting, dimensional analysis, Alerts/Notifications, Visualization: Charts, Graphs, Widgets, Scorecards and Dashboards, Geographic Visualization, Integrated Analytics, Considerations: Optimizing the Presentation for the Right Message.

Unit:3	ANALYSING EFFICIENCY	12 hours

Efficiency: Efficiency measures – The CCR model: Definition of target objectives- Peer groups – Identification of good operating practices; cross efficiency analysis – virtual inputs and outputs – Other models. Pattern matching – cluster analysis, outlier analysis.

Unit:4	BUSINESS INTELLIGENCE APPLICATIONS	13 hours

Business Intelligence Applications: Marketing models – Logistic and Production models – Case studies.		
Unit:5	**FUTURE OF BUSINESS INTELLIGENCE**	**12 hours**
Future of Business Intelligence: Future of business intelligence – Emerging Technologies, Machine Learning, Predicting the Future, BI Search & Text Analytics – Advanced Visualization – Rich Report, Future beyond Technology.		
Unit:6	**Contemporary Issues**	**2 hours**
Discussion on case study - Expert lectures - Online seminars − Webinars − Workshops		
	Total Lectures	**62 hours**
Text Books		
1	Efraim Turban, Ramesh Sharda, Dursun Delen, "Decision Support and Business Intelligence Systems", 9th Edition, Pearson 2013.	
Reference Books		
1	Larissa T. Moss, S. Atre, "Business Intelligence Roadmap: The Complete Project Lifecycle of Decision Making", Addison Wesley,	
2	David Loshin Morgan, Kaufman, "Business Intelligence: The Savvy Manager"s Guide", Second Edition, 2012.	
3	Cindi Howson, "Successful Business Intelligence: Secrets to Making BI a Killer App", McGraw-Hill, 2007.	
4	Carlo Vercellis, "Business Intelligence: Data Mining and Optimization for Decision Making", Wiley Publications, 2009	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://www.classcentral.com/course/swayam-business-analytics-for-management-decision-10050	
2	https://www.coursera.org/specializations/business-analytics	
3	https://www.udacity.com/course/business-analytics-nanodegree--nd098	
4	https://www.tutorialspoint.com/business_analysis/business_analysis_quick_guide.htm	
Course Designed By: **Dr.R.Porkodi**		

Mapping with programme outcomes:

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	L	S	M	L	L	L	M	M
CO2	S	S	M	M	M	M	L	M	S	S
CO3	S	S	M	S	M	M	L	L	M	S
CO4	S	S	S	S	M	M	L	L	S	S
CO5	S	L	S	S	M	L	L	M	S	S

S- Strong; M-Medium; L-Low

Course code	23DS2E1	TRANSFORMS AND APPLICATIONS	L	T	P	C
Core/Elective/Supportive		ELECTIVE	4	0	0	4
Pre-requisite		Basic knowledge in Calculus	Syllabus Version		2022-2023	

Course Objectives:

The main objectives of this course are to:

1. Acquaint the students some simple concepts like harmonic decomposition, convolution, etc.
2. Introduce some useful transforms, continuous and discrete, to solve equations of the real world.
3. Discuss various properties of the transforms

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

CO1	Learn the basic concepts of Laplace Transform, Z transform and fourier transform and their properties	K1
CO2	Select the appropriate method to solve mathematical problems.	K2
CO2	Apply Laplace transform to differential equations	K3
CO3	Understand and evaluate partial derivatives and integrals of multivariable functions.	K4
CO4	Find the Fourier transform, inverse Fourier transform and Residue of a function.	K5
CO5	Apply Z transform to difference equations	K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit 1	Laplace Transform	12 hours

The Laplace transform: Definition and notation - transforms of simple functions - existence of Laplace transform- properties of the Laplace transform - table of Laplace transforms - the inverse transform - evaluation of inverse transforms - inversion using first shift theorem - Step and impulse functions: the Heaviside step function - Laplace transform of unit step function - the second shift theorem-inversion using the second shift theorem - Solution of differential equations: transforms of derivatives- transforms of integrals- ordinary differential equations.

Unit 2	Z Transform	14 hours

The z transform: definition and notation - Properties of the z transform: linearity property - first shift property - second shift property - some further properties -table of z transforms- The inverse z transform: inverse techniques- Discrete-time systems and difference equations: difference equations- the solution of difference equations.

Unit 3	Fourier Series	14 hours

Fourier series expansion: periodic functions -Fourier's theorem - functions of period 2\pi - even and odd functions - linearity property - functions of period T - Functions defined on a finite interval: full-range series - half-range cosine and sine series - Complex form for Fourier series: complex representation - the multiplication theorem and Parseval's theorem.

Unit 4	Fourier Transform	15 hours

The Fourier transform: the Fourier integral - the Fourier transform pair - continuous Fourier spectra -

Properties of the Fourier transform: linearity property- time-differentiation property- time-shift property- frequency-shift property- symmetry property- Transforms of the step and impulse functions: energy and power- convolution.		
Unit 5	**Fourier Transform (continued)**	**18 hours**
The Fourier transform in discrete time: a Fourier transform for sequences- the discrete Fourier transform- the fast Fourier transform.		
Unit 6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars - webinars		
	Total Lecture hours	**75 hours**

Text Book(s)	
1	"Advanced Modern Engineering Mathematics" by **G. James,** Fourth Ed., 2011 Pearson. Unit I : Chapter 5: Sections 5.2, 5.3 & 5.5 (only first four subsections); Unit II : Chapter 6: Sections 6.2, 6.3, 6.4& 6.5; Unit III: Chapter 7: Sections 7.2 (excluding 7.2.9), 7.3, 7.6 (only first two subsections); Unit IV: Chapter 8: Sections 8.2, 8.3, 8.5; Unit V : Chapters 6 : Chapter 8: Section 8.6 (excluding 8.6.4)
Reference Books	
1	**L. Debnath& D. Bhatta**, Integral Transforms and their Applications, CRC Press, 2015.
2	**E. Kreyszig,** "Advanced Engineering Mathematics" Wiley, 2017.
3	**C.R. Wylie & L.C. Barret,** "Advanced Engineering Mathematics", McGraw Hill, 2013.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/courses/111105035
2	https://nptel.ac.in/courses/111106046
3	https://www.youtube.com/watch?v=gZNm7L96pfY
Course Designed By: **Dr.R.Rakkiyappan and Dr.S.Saravanan**	

Course Code	23DS2E2	PREDICTIVE ANALYTICS	L	T	P	C
Core/Elective/Supportive		ELECTIVE	4	0	0	4
Pre-requisite		Basics of Mathematics and Statistics	Syllabus Version		2022-2023	

Course Objectives

The main objectives of this course are to:
1. introduce the concept of forecasting
2. develop analytical skill in fitting regression models
3. provide the methodical approach for building time series models
4. impart the knowledge of assessing pattern of time series data plot and measuring the trend
5. understand the concept of Box-Jenkins methodology and its application in forecasting

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Identify the time series data patterns	K1-K3
2	Forecast future values by selecting the suitable time series models	K4-K5
3	Fit a linear regression model	K4-K5
4	Measure the linear trend in a time series plot	K3,K5
5	Apply Box-Jenkins methodology to identify a suitable time series model	K4-K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit 1	Forecasting	12 Hours

Forecasting: Nature and Uses – Forecasting Process – Time Series Plot – Plotting Smoothed Data Exploring Time Series Data Pattern – Auto-covariance and Auto-correlation Functions – Correlogram – General Approach to Time Series Modeling and Forecasting- Evaluating and Monitoring Forecasting Model Performance.

Unit 2	Forecasting Methodology	12 hours

Forecasting techniques – Measuring Forecast Error – Applications – Moving averages and Smoothing Methods - Naïve Models – Simple and Moving Average Methods – Exponential Smoothing: First Order Exponential Smoothing – Holt - Winter Forecast Methods.

Unit 3	Regression Analysis	12 hours

Linear Regression Models – Least Squares Estimation – Test for Significance of Regression – Confidence Interval on Regression Coefficients and Mean Response – Prediction of New Observation – Model Adequacy Checking: Residual Plots, Measures of Leverage and Influence – Regression Models for Time Series Data – Autocorrelation and Durbin-Watson Test.

Unit 4	Time Series Analysis	12 hours

Time Series – Components of Time Series: Trend, Seasonal Variation, Cyclical Variation and Irregular Variations – Additive and Multiplicative Models - Methods of Measuring Trend - Linear, Quadratic and Exponential Trends – Logistic Growth Model - Simple problems.

Unit 5	Box-Jenkins Methodology	12 hours

Stationary and Nonstationary Time Series Data - Box-Jenkins Methodology: Autoregressive, Moving Average, Autoregressive Moving Average, Autoregressive Integrated Moving Average Models - Model Building Strategy - Model Selection Criteria – Diagnostic Checking.		
Unit 6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars - webinars		
	Total Lecture Hours	**62 hours**

Reference Books	
1	Hanke, J. E., and Wichern, D. (2014). Business Forecasting, Ninth Edition, Pearson New International Edition.
2	Montgomery, D. C., Jennings, C. L., Kulahci, M. (2015). Introduction to Time Series Analysis and Forecasting, Second Edition, Wiley.
3	Box, G.E.P., Jenkins, G.M., Reinsel, G. C., and Ljung, G.M. (2015). Time Series Analysis: Forecasting and Control, Fifth Edition, John-Wiley & Sons, New Jersey
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/courses/103106123
2	https://nptel.ac.in/courses/111104098
3	https://onlinecourses.nptel.ac.in/noc21_ch28/preview
4	https://archive.nptel.ac.in/courses/111/104/111104098/
Course Designed By: Dr. R. Vijayaraghavan / Dr. R. Muthukrishnan	

***Note*: This paper is application oriented. The derivation of the formulae and equations is outside the scope of the paper and hence, it may be avoided.**

Course code	23DS2E3	SOFTWARE PROJECT MANAGEMENT	L	T	P	C
Core/Elective/Supportive		ELECTIVE	4	0	0	4
Pre-requisite		Students should have prior experience and knowledge as members of software development.	Syllabus Version		2022-2023	

Course Objectives:

- To outline the need for Software Project Management
- To highlight different techniques for software cost estimation and activity planning.
- To define and highlight importance of software project management
- To describe the software project management activities
- To train software project managers and other individuals involved in software project
- To planning and tracking and oversight in the implementation of the software project management process.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understand the practices and methods for successful software project management	K2/ K3
2	Describe and determine the purpose and importance of project management from the perspectives of planning, tracking and completion of project	K1/K3
3	Identify techniques for requirements, policies and decision making for effective resource management	K4/ K5
4	Compare and differentiate organization structures and project structures	K3/ K5
5	Devise a framework for software project management plan for activities, risk, monitoring and control	K6/ K4
6	Devise a framework to manage people	K6/ K3

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit 1	Introduction to Software Project Management	10 hours

What is Software Project Management – Categorization of Software Projects- Project management skills- The role and responsibility of a software project manager- How to manage a software project successfully?- Project Plan - Project management steps and Principles – The scenario in a software project- Roles & Responsibilities- Gantt chart- Pert chart- The project management process: the phases- Deal with uncertainties in software development- The customers role in software development projects.

Unit 2	**Software Development Models & Risk Assessment**	**12 hours**
General- Software Development Life Cycle (SDLC)- What are the Software Development Life Cycle (SDLC) phases? - Waterfall model- V Model-Incremental model-RAD model- Agile model-Iterative model- Spiral model- Prototype model - Constructive Cost Model (COCOMO)- Introduction -Software Risk Identification-Software Risk Analysis-Software Risk Planning-Software Risk Monitoring-Contingency Plans-Presentation of the typical risk report.		
Unit 3	**Activity planning**	**12 hours**
Objectives of Activity Planning - Project Schedules - Sequencing and Scheduling Activities - Network Planning Models- Forward Pass – Backward Pass- Identifying critical path- Activity on Arrow Networks- Risk Management- Nature of Risk- Categories of Risk- A framework for dealing with Risk- Risk Identification- Risk analysis and prioritization- Risk planning and Risk monitoring.		
Unit 4	**Monitoring and Managing People**	**12 hours**
Creating the Framework - Collecting the Data – Review- Project Termination Review- Visualizing Progress- Cost Monitoring- Earned Value Analysis- Prioritizing Monitoring- Getting Project Back to Target- Change Control- Software Configuration Management Introduction to managing people- Understanding Behavior- Organizational Behavior: A Background- Selecting the Right Person for the Job- The Oldham –Hackman Job Characteristics Model- Stress – Decision Making- Leadership.		
Unit 5	**Project Leadership and Closure of a Project**	**12 hours**
Introduction - Project Leadership- Modern approaches- Styles of leadership – Introduction to Closure of a Project - Project implementation - Administrative closure - Project Evaluation.		
Unit 6	**Contemporary Issues**	**2 hours**
Discussion on case study - Expert lectures - Online seminars – Webinars – Workshops		
	Total Lecture hours	**60 hours**

Text Book(s)

1	Software Project Management , Hughes , McGraw Hill Education ;5 th edition(1July 2017)
2	Bob Hughes, Mike Cotterell, Rajib Mall, “Software Project Management”, Fifth Edition, Tata McGraw Hill, 2011.
3	Introduction to Software Project Management, Adolfo Villafiorita, Auerbach Publications, 2014
4	Effective Software Project Management, Robert K. Wysocki, Willey ,March 2006

Reference Books

1	JackMarchewka," Information Technology-Project Management", Wiley Student Version, 4th Edition, 2013.
2	James P Lewis,"Project Planning, Scheduling & Control", McGraw Hill, 5th Edition, 2011.
3	PankajJalote," Software Project Management in Practise", Pearson Education, 2002
4	Samuel J mantel et.el, Project Management Core Textbook, Wiley India.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/courses/106105218
2	https://onlinecourses.swayam2.ac.in/cec20_cs07/preview
3	https://www.classcentral.com/course/swayam-project-management-7912
Course Designed By: **Dr. D.NAPOLEON**	

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	M	S	S	M	S	S
CO2	M	S	L	S	S	M	M	S	M	M
CO3	M	M	M	S	M	S	S	S	S	L
CO4	S	S	L	M	S	L	L	L	S	S
CO5	M	M	S	L	M	M	L	S	L	M

S- Strong; M-Medium; L-Low

Course Code	23DS3E1	NATURAL LANGUAGE PROCESSING	L	T	P	C
Core/Elective/Supportive		ELECTIVE	4	0	0	4
Pre-Requisite		Fundamentals of finite automata, regular expressions and grammar structures.	Syllabus Version		2023-2024	

Course Objective:

The main objectives of this course are:

1. To understand algorithms for the processing of linguistic information and computational properties of natural languages.
2. To conceive basic knowledge on various morphological, syntactic and semantic NLP tasks.
3. To familiarize various NLP software libraries and data sets publicly available.
4. To develop systems for various NLP problems with moderate complexity.
5. To learn steps for creating Machine learning models.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Describe the concepts of morphology, syntax, semantics, discourse & pragmatics of natural language.	K1/K2
2	Demonstrate understanding of the relationship between NLP and statistics & machine learning.	K2/K4
3	Discover various linguistic and statistical features relevant to the basic NLP task, namely, spelling correction, morphological analysis, parts-of-speech tagging and syntactic parsing.	K2/K4
4	Demonstrate the concept of semantic analysis and word sense disambiguation.	K2/K4
5	Understand the components of machine translation process and develop the model for NLP applications.	K2/K3/K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	INTRODUCTION	10

Introduction - NLP tasks in syntax, semantics, and pragmatics. Applications such as information extraction, question answering, and machine translation. The problem of ambiguity. The role of machine learning. Brief history of the field - N-gram Language Models - The role of language models. Simple N- gram models. Estimating parameters and smoothing. Evaluating language models.

Unit:2	BASIC NLP TECHNIQUES	12

Part Of Speech Tagging and Sequence Labeling - Lexical syntax. Hidden Markov Models (Forward and Viterbi algorithms and EM training) - Basic Neural Networks. Any basic introduction to perceptron and backpropagation

Unit:3	PARSING	13

LSTM Recurrent Neural Networks -Syntactic parsing - Grammar formalisms and treebanks. Efficient parsing for context-free grammars (CFGs). Statistical parsing and probabilistic CFGs (PCFGs). Lexicalized PCFGs. Neural shift-reduce dependency parsing

Unit:4	**SEMANTIC ANALYSIS**	**12**
Lexical semantics and word-sense disambiguation. Compositional semantics. Semantic Role Labelling and Semantic Parsing		
Unit:5	**MACHINE TRANSLATION**	**13**
Information Extraction (IE) - Named entity recognition and relation extraction. IE using sequence labelling. -Machine Translation (MT) Basic issues in MT. Statistical translation, word alignment, phrase-based translation, and synchronous grammars.		
Unit:6	**Contemporary Issues**	**2**
Discussion on case study - Expert lectures - Online seminars – Webinars – Workshops		
	Total Lectures	**62**
Text Books		
1	Jurafsky Dan and Martin James H. “Speech and Language Processing” ,3rd Edition, 2018.	
Reference Books		
1	Sowmya Vajjala, Bodhisattwa Majumder, Anuj Gupta, Harshit Surana, Practical Natural Language Processing, 2020.	
2	Steven Bird, Ewan Klein, Edward Loper., Natural Language Processing with Python, 2009.	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://onlinecourses.nptel.ac.in/noc19_cs56/preview	
2	https://www.edx.org/learn/natural-language-processing	
3	https://www.coursera.org/specializations/natural-language-processing	
4	https://www.tutorialspoint.com/natural_language_processing/index.htm	
Course Designed By:**Dr.R.Porkodi**		

Mapping with programme outcomes:

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	**S**	**S**	**L**	**M**	**M**	**L**	**L**	**L**	**M**	**S**
CO2	**S**	S	**M**	**M**	**M**	**M**	**M**	**L**	**M**	**S**
CO3	**S**	**S**	**M**	**M**	**M**	**M**	**M**	**L**	**M**	**S**
CO4	**S**	**S**	**M**	**M**	**M**	**M**	**M**	**L**	**M**	**S**
CO5	**S**	**S**	**M**	**L**	**M**	**L**	**M**	**L**	**S**	**S**

S- Strong; M-Medium; L-Low

Course Code	23DS3E2	SOCIAL MEDIA ANALYTICS	L	T	P	C
Core/Elective/Supportive		ELECTIVE	4	0	0	4
Pre-requisite		Foundations of Data Science Big data framework	Syllabus Version		2023-2024	

Course Objectives:

The main objectives of this course are:

1. To provide an overview of common text mining and social media data analytic activities.
2. To understand the complexities of processing text and network data from different data sources.
3. To enable students to solve complex real-world problems for recommendation systems.
4. To enable the learners to develop skills required for analyzing the effectiveness of social media for business purposes.
5. To familiarize the learners with the concept of social media analytics and understand its significance.
6. To familiarize the learners with the tools of social media analytics.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understand the terminologies, metaphors and perspectives of social media analytics	K1/K2
2	Apply a wide range of classification, clustering, estimation and prediction algorithms on Textual data.	K3/K4
3	Perform social network analysis to identify important social actors, subgroups and network properties in social media sites.	K2/K4
4	Apply state of the art web mining tools and libraries on realistic data sets as a basis for business decisions and applications.	K2/K3/K4
5	Provide solutions to the emerging problems with social media such as behavior analytics and Recommendation systems	K2/K3/K4
6	Design new ontology-based solutions for opinion extraction, sentiment classification and data summarization problems.	K2/K3/K4/K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Foundation for Social Media Analytics	7 hours

Foundation for Analytics: – Digital Gap – Social Media Data Sources – Defining Social Media Data –Data Sources – Estimated vs. Factual Data Sources – Data Gathering in Social Media Analytics. From Data to Insights: Actionable Analytics – Focus on objective – Plan to shape data to insights –Choosing a good analytics tool – Data Aggregation calculations and display – Data display – Social-Media and Big data – Potential Challenges. Data Identification: Professional networking sites - social sites – information sharing sites – micro blogging sites – blogs /wikis.

Unit:2	Social Media Analytics Types, Tools and Social Network Landscape	8 hours

Analytics in social media: Types of analytics. Dedicated Vs. Hybrid Tools – Dedicated tools – Hybrid tools – Data Integration Tools – Best Setup. Social Network Landscape: Concept and UX on social networks – Interactivity of social network –Content flow on social network – Interaction Pattern between users – Social-Media as a two-way channel.

Unit:3	**Analytic Process and Metrics**	**1 0 hours**
Analytics Process: Analysis – Insight – Investigation beyond social analytics – Shaping a method –analysis cycle – Community Activity – Resources – Attention span – Dynamic cycles – Short Periods –Long Periods – Analyst Mindset – Instinctive Analyst. Metrics: Introduction – Default and custom metrics – Metrics Categories – Graph Types – Metric Capabilities – Metrics and Strategy – Estimated Metrics – Metrics and Tactics.		
Unit:4	**Semantic Web and Social Network Analysis**	**9 hours**
Introduction to Semantic Web: Limitations of current Web, Development of Semantic Web, Emergence of the Social Web. Social Network analysis: Development of Social Network Analysis -Key concepts and measures in network analysis. Electronic sources for network analysis: Electronic discussion networks, Blogs and online communities - Web-based networks.		
Unit:5	**Semantic Web and Ontology**	**11 hours**
Knowledge representation on the Semantic web: Ontology and their role in the Semantic Web: Ontology-based knowledge Representation – Ontology languages for the Semantic Web: Resource Description Framework - Web Ontology Language.		
Unit:6	**Contemporary Issues**	**2 hours**
Online Courses, Webinars and Case studies		
	Total Lecture hours	**60 hours**

Text Book(s)	
1	Alex Goncalves, “Social Media Analytics Strategy - Using Data to Optimize Business Performance”, Alex Goncalves, APress 2017.
2	Peter Mika, “Social Networks and the Semantic Web”, First Edition, Springer 2007.
Reference Books	
1	Ganis, Kohirkar (2016). Social media Analytics, IBM Press PTG, 1st Edition.
2	Nancy Flynn (2012). The Social Media Hand book Policies, and Best Practices, Wiley.
3	Guandong Xu ,Yanchun Zhang and Lin Li, “Web Mining and Social Networking –Techniques and applications”, First Edition Springer, 2011.
4	Dion Goh and Schubert Foo, “Social information Retrieval Systems: Emerging Technologies and Applications for Searching the Web Effectively”, IGI Global Snippet, 2008.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.coursera.org/learn/social-media-data-analytics
2	https://www.classcentral.com/course/social-media-analytics-introduction-6916
3	https://und.edu/academics/online/enroll-anytime/comm499.html

Course Designed By: Dr. P.B.Pankajavalli

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	S	S	M	L	L	M	M	M
CO2	S	S	S	S	M	L	M	M	S	S
CO3	S	S	S	S	S	M	M	M	S	S
CO4	S	S	S	S	S	M	M	M	S	S
CO5	S	S	S	S	M	M	M	S	S	S
CO6	S	S	S	S	S	M	M	S	S	S

*S-Strong; M-Medium; L-Low

Course Code	23DS3E3	HEALTHCARE ANALYTICS	L	T	P	C
Core/Elective/Supportive		ELECTIVE	4	0	0	4
Pre-Requisite		Fundamentals of Data mining	Syllabus Version		2023-2024	

Course Objective:

The main objectives of this course are:

1. To understand the various formats of electronic health care information and its challenges.
2. To learn depth knowledge on the techniques used to analyse health care data.
3. To understand the various analytical methods on processing healthcare data and privacy preservation of health care data.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understand the different formats of healthcare data, resources and its challenges while processing it.	K1/K2
2	Analysis of healthcare data from various data sources like imaging, sensing, signalling and genomic data.	K2/K3/K4
3	Apply analytics in natural language clinical text, biomedical literature and social media text for decision making in healthcare services.	K3/K5
4	Apply clinical predictive models to healthcare data to provide health outcomes in relevant populations of interest.	K3/K4
5	Understand and apply the relevant data analytic models to build decision support systems for healthcare domain.	K3/K4/K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	INTRODUCTION TO HEALTHCARE ANALYSIS	10

Introduction to Healthcare Data Analytics- Applications and practical systems for Healthcare – Resources for healthcare data analytics - Electronic Health Records - Components of HER - Coding Systems - Benefits of EHR- Barrier to Adopting HER Challenges- Phenotyping Algorithms.

Unit:2	HEALTHCARE DATA SOURCES AND ANALYSIS	12

Biomedical Image Analysis: Imaging Modalities – Object detection – Segmentation - Mining of Sensor Data in Healthcare: Challenges – Sensor data mining applications – Nonclinical healthcare applications – Biomedical Signal Analysis- Genomic Data Analysis for Personalized Medicine – Types of computational genomics.

Unit:3	HEALTH CARE ANALYTICS	13

Natural Language Processing and Data Mining for Clinical Text- Challenges in processing in clinical reports – Clinical applications - Mining the Biomedical literature – Named entity recognition and extraction - Social Media Analytics for Healthcare – analytics on public health research.

Unit:4	ADVANCED DATA ANALYTICS ON HEALTHCARE	13

Advanced Data Analytics for Healthcare: Review of Clinical Prediction Models- Temporal Data Mining for Healthcare Data- Visual Analytics for Healthcare- Predictive Models for Integrating

Clinical and Genomic Data- Information Retrieval for Healthcare- Privacy-Preserving Data Publishing Methods in Healthcare.		
Unit:5	**CASE STUDIES: HEALTHCARE APPLICATIONS**	**12**
Applications: Applications and Practical Systems for Healthcare– Data Analytics for Pervasive Health- Fraud Detection in Healthcare- Data Analytics for Pharmaceutical Discoveries- Clinical Decision Support Systems- Computer-Assisted Medical Image Analysis Systems- Mobile Imaging and Analytics for Biomedical Data.		
	Total Lectures	**60**
Text Books		
1	Chandan K.Reddy, Charu C. Aggarwal, “Health Care data Analysis”, First edition, CRC, 2015.	
2	Vikas Kumar, “Health Care Analysis Made Simple”, Packt Publishing, 2018.	
Reference Books		
1	Nilanjan Dey, Amira Ashour, Simon James Fong, Chintan Bhatl, “Health Care Data Analysis and Management, First Edition, Academic Press, 2018.	
2	Hui Jang, Eva K.Lee, “HealthCare Analysis : From Data to Knowledge to Healthcare Improvement”, First Edition, Wiley, 2016.	
3	Kulkarni, Siarry, Singh, Abraham, Zhang, Zomaya, Baki, “Big Data Analytics in HealthCare”, Springer, 2020.	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://www.coursera.org/courses?query=healthcare%20analytics	
2	https://onlinecourses.nptel.ac.in/noc22_hs40/preview	
3	https://www.udacity.com/course/health-informatics-in-the-cloud--ud809	
Course Designed By: **Dr.R.Porkodi**		

Mapping with programme outcomes:

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	**S**	**S**	**L**	**S**	**M**	**L**	**L**	**L**	**M**	**M**
CO2	**S**	S	**M**	**M**	**M**	**M**	**L**	**M**	**S**	**S**
CO3	**S**	**S**	**M**	**S**	**M**	**M**	**L**	**L**	**M**	**S**
CO4	**S**	**S**	**S**	**S**	**M**	**M**	**L**	**L**	**S**	**S**
CO5	**S**	**S**	**S**	**S**	**M**	**L**	**L**	**M**	**S**	**S**

S- Strong; M-Medium; L-Low

Course code	23DS3E4	NATURE INSPIRED COMPUTING	L	T	P	C
Core/Elective/Supportive		ELECTIVE	4	0	0	4
Pre-requisite		Familiarity with programming language such as C / C++ / Java / Matlab / Python with knowledge of basic optimization methods	Syllabus Version		2023-2024	

Course Objectives:

The main objectives of this course are to:

1. Inculcate knowledge of Nature Inspired Computing Techniques and their working principle.
2. Identify the suitable Nature Inspired Computing Techniques to solve a problem.
3. Generate the possible ways of solution to a certain real world problem using Nature Inspired Computing Techniques
4. Analyze and modify the performance of the Nature Inspired Computing algorithms.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Identify the Nature Inspired Computing Techniques and their classifications.	K2/K3
2	Understating evolutionary theory to develop Nature Inspired algorithms	K2
3	Design and develop Nature Inspired algorithms	K2/K3
4	Apply swarm intelligence to practical problems.	K2/K3
5	Understand immune algorithms	K2

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Introduction to Nature Inspired Computing	10 hours

Computation Inspired by Nature- Evolution Versus Learning-, Swarm Intelligence-Group Behaviors- Foraging Theory- Heuristics, Metaheuristics, and Hyper-Heuristics- Stochastic algorithms-Searching -Random search-Stochastic Hill Climbing-iterated Local search- Variable Neighborhood search- Greedy Randomized Adaptive search- Tabu search

Unit:2	Evolutionary Algorithms	12 hours

Introduction to Evolutionary Computation -Evolutionary Algorithms Versus Simulated Annealing- Terminology- Encoding/Decoding- Selection/Reproduction - Crossover- Mutation - Noncanonical Genetic Operators -Exploitation Versus Exploration-Genetic Algorithms for Sequence Optimization

Unit:3	Physical and Probabilistic Algorithm	12 hours

Simulated Annealing- External optimization- Harmony search – Cultural algorithm- Memetic Algorithm- Population based Incremental Learning- Compact Genetic Algorithm- Bayesian Optimization Algorithm

Unit:4	Swarm Algorithms	12 hours

Particle swarm Optimization- Ant System- Ant Colony Systems – Bees Algorithm- Bacterial

Foraging Optimization Algorithm		
Unit:5	**Immune Algorithms**	**12 hours**
Introduction- Immune Theories- Immune Algorithms-Clonal Selection Algorithm-Negative selection algorithm- Artificial immune Recognition system- Immune network Algorithm- Dendritic Cell Algorithm		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars - webinars		
	Total Lecture hours	**60 hours**

Text Book(s)	
1	Ke-Lin Du and M.N. S. Swamy, Search and Optimization Metaheuristics- Techniques and Algorithms Inspired by Nature, Springer, Birkhauser, 2016
2	Jason Brownlee, Clever Algorithms- Nature Inspired Programming Recipes, LuLu, 2011
Reference Books	
1	Xin-She Yang, Nature-Inspired Optimization Algorithms, Elsevier, 2014, ISBN 9780124167438. 2. Introduction to Nature-Inspired Optimization, Editor(s): George Lindfield, John Penny, Academic Press, 2017, ISBN 9780128036365.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.tutorialspoint.com/ebook/natural_computing_with_python/index.asp
2	https://www.tutorialspoint.com/genetic_algorithms/genetic_algorithms_quick_guide.htm
Course Designed By: Dr. K. Geetha	

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	**S**	**S**	**S**	**M**	**S**	**M**	L	L	**M**	**S**
CO3	**S**	**S**	**S**	**M**	**S**	**M**	L	L	**M**	**S**
CO3	**S**	**S**	**S**	**M**	**S**	**M**	L	L	**M**	**S**
CO4	**S**	**S**	**S**	**M**	**S**	**M**	L	L	**M**	**S**
CO5	**S**	**S**	**S**	**M**	**S**	**M**	L	L	**M**	**S**

***S-Strong; M-Medium; L-Low**

Course code	23DS3E5	CLOUD SECURITY	L	T	P	C
Core/Elective/Supportive		ELECTIVE	4		0	4
Pre-requisite		Basic knowledge of could environment	Syllabus Version		2023-2024	

Course Objectives:

The main objectives of this course are to:

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	To understand fundamental of cloud and its architecture	K1/K2
2	To know about security fundamentals and its issues in cloud environment	K1/K2/K4
3	To familiar with security challenges and security architecture	K2/K3/K4
4	To understand about life cycle issues in cloud environment	K1/K2
5	To know about standards available in cloud computing for security	K2/K3

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Cloud computing Fundamentals	8-- hours

Fundamentals -Essential Characteristics - Architectural Influences - High-Performance Computing - Utility and Enterprise Grid Computing - Autonomic Computing - Service Consolidation - Horizontal Scaling - Web Services - High-Scalability Architecture - Technological Influences - Universal Connectivity - Commoditization - Excess Capacity - Open-Source Software - Virtualization - Operational Influence- .Cloud Computing Architecture

Unit:2	Cloud Computing Software Security Fundamentals snd Risk Issues	12-- hours

Cloud information security objectives- CIA- security services- Cloud security design principles- Cloud software Testing- Cloud Computing Risk Issues - The CIA Triad - Privacy and Compliance Risks - - Threats to Infrastructure, Data, and Access Control - Common Threats and Vulnerabilities- Cloud access Control Issues- Cloud Service Provider Risks

Unit:3	Cloud Computing Security Challenges and Security Architectures	10-- hours

Cloud Computing Security Challenges - Security Policy Implementation - Policy Types – Computer Security Incident Response Team- Virtualization Security Management - Virtual Threats - VM Security Recommendations - VM-Specific Security Techniques- Security Architecture – Architectural Consideration – Identify Management and access control- Autonomic Security. Security Awareness, Training, and Education - Secure Execution Environment.

Unit:4	Life Cycle Issues	12-- hours

The Distributed Management Task Force – ISO- The Organization for the Advancement of

Structured Information Standards - Storage Networking Industry Association- Open Grid Forum - The Open Web Application Security Project - Incident Response - Internet Engineering Task Force Incident-Handling Guidelines - Layered Security and IDS – Computer Security and incident response teams - Security Incident Notification Process - Automated Notice and Recovery Mechanisms - Encryption and Key Management – Hardware and Software-Based Protection - - VM Life Cycle		
Unit:5	**Common Standards in Cloud Computing**	**12-- hours**
The Open Cloud Consortium - The Distributed Management Task Force - Standards for Application Developers-Standards for Messaging - Simple Message Transfer Protocol - Post Office Protocol - Internet Messaging Access - Protocol - Syndication - Communications - Standards for Security - Security –SAML, OAuth, OpenID, SSL, TLS.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars - webinars		
	Total Lecture hours	**56-- hours**

Text Book(s)	
1	Cloud Security- A Comprehensive Guide to Secure Cloud Computing, Ronald L. Krutz Russell Dean Vines, Wiley Publishing, Inc, 2010
2	Cloud Computing-Implementation, Management, and Security, John W. Rittinghouse James F. Ransome, CRC Press, 2010
Reference Books	
1	Secure Cloud Computing, Sushil Jajodia • Krishna Kant Pierangela Samarati • Anoop Singhal Vipin Swarup • Cliff Wang, Springer,
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.tutorialspoint.com/cloud_computing/cloud_computing_challenges.htm
2	https://www.tutorialspoint.com/cloud_security_with_aws_and_microsoft_azure/index.asp

Course Designed By: Dr. K. Geetha

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	**S**	**S**	**L**	**S**	**M**	**L**	**L**	**L**	**M**	**M**
CO3	**S**	S	**M**	**M**	**M**	**M**	**L**	**M**	**S**	**S**
CO3	**S**	**S**	**M**	**S**	**M**	**M**	**L**	**L**	**M**	**S**
CO4	**S**	**S**	**S**	**S**	**M**	**M**	**L**	**L**	**S**	**S**
CO5	**S**	**S**	**S**	**S**	**M**	**L**	**L**	**M**	**S**	**S**

*S-Strong; M-Medium; L-Low

Course code	23DS3E6	SENTIMENT ANALYSIS	L	T	P	C
Core/Elective/Supportive		ELECTIVE	4	0	0	4
Pre-requisite		Knowledge on social media and good analytical skills	Syllabus Version		2022-2023	

Course Objectives:

The main objectives of this course are to:

1. Understand the problems of sentiment analysis
2. Understand the sentiment classification of documents
3. Understand the extraction of entities
4. Detect the fake or deceptive opinions

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understand the concepts on sentiment analysis and apply for different problems	K2/K3
2	Design and apply supervised sentiment classification	K1/K3
3	Understand and evaluate different approaches for aspect and entity extraction	K2/K5
4	Design and create sentiment analysis applications	K6
5	Analyze the fake or deceptive opinions and discovering abnormal patterns	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	INTRODUCTION	9 hours

Introduction to Sentiment Analysis – Applications – Sentiment Analysis Research – The Problem of Sentiment Analysis – Opinion – Opinion Summary – Affect, Emotion and Mood – Different types of opinions

Unit:2	SENTIMENT CLASSIFICATION	12 hours

Document Sentiment Classification – Supervised Sentiment Classification – Unsupervised Sentiment Classification – Sentiment Rating Prediction – Cross-Domain Sentiment Classification – Cross-language Sentiment Classification – Emotion Classification of Documents – Sentence Subjectivity and Sentiment Classification.

Unit:3	ASPECT SENTIMENT CLASSIFICATION	12 hours

Aspect Sentiment Classification -Supervised Learning – Lexicon Based Approach - Rules of Sentiment Composition – Negation and Sentiment.

Unit:4	ASPECT AND ENTITY EXTRACTION	12 hours

Frequency Based Aspect Extraction – Exploiting Syntactic Relations – Using Supervised Learning – Mapping Implicit Aspects – Grouping Aspects into categories – Exploiting Topic Models – Entity Extraction and Resolution – Opinion Holder and Time Extraction - Sentiment Lexicon Generation – Dictionary-Based Approach – Corpus Based Approach		
Unit:5	**FAKE DETECTION**	**13 hours**
Detecting Fake or Deceptive Opinions – Spam types – Supervised Fake Review Detection – Supervised Yelp Data Experiment – Automated Discovery of Abnormal Patterns – Model Based Behavioral Analysis – Group Spam Detection – Identifying Reviewers with Multiple User IDs -Quality of Reviews.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars - webinars		
	Total Lecture hours	**60 hours**

Text Book(s)	
1	Bing Liu, Sentiment Analysis: Mining Opinions, Sentiments, and Emotions, 2nd Edition, Cambridge University Press, December 2020.
Reference Books	
1	Bing Liu, "Sentiment Analysis and Opinion Mining", Morgan and Claypool publishers, 2012.
2	Bo Pang and Lillian Lee, "Opinion Mining and Sentiment Analysis", Now Publishers Inc,2008.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.udemy.com/course/r-social-media-mining-scraping-with-twitter/?gclid=Cj0KCQjw3v6SBhCsARIsACyrRAk2uLHSInHXsHsDdkMrKgaef_p7cGhaftEPLJTpav8tiB4pzLTN-koaAkKFEALw_wcB&matchtype=b&utm_campaign=LongTail_la.EN_cc.INDIA&utm_content=deal4584&utm_medium=udemyads&utm_source=adwords&utm_term=_._ag_77882235303_._ad_533195992030_._kw_%2Bsentiment+%2Banalysis+%2Bclass_._de_c_._dm__._pl__._ti_kwd-702523984287_._li_1007810_._pd__._
2	https://www.coursera.org/lecture/text-mining/5-6-opinion-mining-and-sentiment-analysis-sentiment-classification-9zE5i
Course Designed By: **Dr.D.RAMYACHITRA**	

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	L	M	M	L	L	L	M	S
CO2	S	S	S	M	S	M	M	L	L	S
CO3	S	S	M	S	M	L	L	M	L	S
CO4	S	S	S	M	S	L	M	M	L	S
CO5	S	S	S	S	S	M	L	L	M	S

*S-Strong; M-Medium; L-Low

Course code	23DS3E7	TEXT ANALYTICS	L	T	P	C
Core/Elective/Supportive		ELECTIVE	4		0	4
Pre-requisite		Familiarity of programming with basic mathematical foundation and language structures	Syllabus Version		2023-2024	

Course Objectives:

The main objectives of this course are to:

- Enhance student knowledge in Text analytics concepts and applications
- To make them familiar about fundamental of Information retrieval and natural language processing
- To make them understand about the framework of Text analytics
- To inculcate theoretical techniques and applications in text analytics

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understand the basics of text analysis	K2
2	Will be able to analyze the text parts	K2/K3
3	Will be able to analyze the text and to classify them into categories	K2/K3/K4
4	Familiar about similarity measure and to cluster texts.	K2/K3/K4/K5
5	Know about semantic and sentiment analysis	K2/K3

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	INTRODUCTION	**8-- hours**

Introduction to Text Analytics - Introduction :Text Analytics: What Is It? - Origins and Timeline of Text Analytics - Text Analytics in Business and Industry - Text Analytics Skills - Benefits of Text Analytics - Text Analytics Process Road Map - Fundamental of content analysis – Deductive Vs Inductive Approaches- Unitizing and the unit of Analysis- Sampling.

Unit:2	PROCESSING AND UNDERSTANDING TEXT	**12-- hours**

Text Tokenization - Sentence Tokenization - Word Tokenization - Text Normalization - Cleaning Text -Tokenizing Text - Removing Special Characters - Expanding Contractions - Case Conversions - Removing Stopwords - Correcting Words - Stemming - Lemmatization - Understanding Text Syntax and Structure - Installing Necessary Dependencies - Important Machine Learning Concepts - Parts of Speech (POS) Tagging - Shallow Parsing - Dependency-based Parsing.

Unit:3	TEXT CLASSIFICATION AND SUMMARIZATION	**12-- hours**

Introduction about Text Classification - automated Text classification- blue print- Text Normalization - Feature Extraction- Automated Text Classification - Text Summarization - Text Summarization and Information Extraction-concepts-topic modeling-automated Document Summarization

Unit:4	TEXT SIMILARITY AND CLUSTERING	**12-- hours**

Concepts --Text Normalization -Feature Extraction -Text Similarity - Analyzing Term Similarity-

Analyzing-Document Similarity - Cosine Similarity - Document Clustering- cluster analysis - Hierarchical Cluster Analysis - K-Means Clustering - Cluster Analysis: Model Fit and Decision-Making.		
Unit:5	SEMANTIC AND SENTIMENT ANALYSIS	**12-- hours**
Semantic Analysis -Exploring WordNet -Understanding Synsets - Analyzing Lexical Semantic Relations - Word Sense Disambiguation - Named Entity Recognition - Analyzing Semantic Representations - Propositional Logic - First Order Logic - Sentiment Analysis - Sentiment Analysis of IMDb Movie Reviews - Setting Up Dependencies - Preparing Datasets --Supervised Machine Learning Technique - Unsupervised Lexicon-based Techniques - Comparing Model Performances.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars - webinars		
	Total Lecture hours	**58-- hours**

Text Book(s)	
1	Text Analytics with Python- A Practical real- Worls Approach to Gaining Actionable Insights from your data, Dipanjan Sarkar,Apress, 2016
2	Practical Text Analytics- Maximizing the value of Text Data, Murugan Anandarajan, Chelsey Hill, Thomas Nolan, Springer, Vol . 2, 2019
3	Text Mining in Practice with R, Ted Kwartler, Wiley,2017
Reference Books	
1	Applied Text Analysis with Pythod- Enabling language-aware data products with machine learing, Benjamin bengfort, Rebecca bilbro &Tony Ojeda, O'reilly, 2018
2	Seven Layers of Social Media Analytics_ Mining Business Insights from Social Media Text, Actions, Networks, Hyperlinks, Apps, Search Engine, and Location Data,Gohar F. Khan, E-Book , 2015
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.coursera.org/learn/text-mining
2	https://www.tutorialspoint.com/big_data_analytics/text_analytics.htm
Course Designed By: Dr. K. Geetha	

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	**S**	**S**	**S**	**S**	**S**	**M**	L	**M**	L	**M**
CO3	**S**	**S**	**S**	**S**	**S**	**M**	L	**M**	L	**M**
CO3	**S**	**S**	**S**	**S**	**S**	**M**	L	**M**	L	**M**
CO4	**S**	**S**	**S**	**S**	**S**	**M**	L	**M**	L	**M**
CO5	**S**	**S**	**S**	**S**	**S**	**M**	L	**M**	L	**M**

*S-Strong; M-Medium; L-Low

Course code	**23DS3E8**	**DIGITAL MARKETING ANALYTICS**	**L**	**T**	**P**	**C**

Core/Elective/Supportive	ELECTIVE	4		0	4
Pre-requisite	There is no prerequisite. However, students would have to become comfortable with data analysis. It would be easier if students have knowledge in handling digital gadgets and about business processes	**Syllabus Version**		**2023-2024**	

Course Objectives:

The main objectives of this course are to:

1. To cover some of the most important aspects of digital marketing analytics since it is the essential tool for optimizing and connecting results of all digital marketing tactics
2. To focus on how digital data handled in media including search, social media, email in the business perspective
3. Will focus on enriching student knowledge in analytics techniques for managerial decisions, which have emerged as the critical assets to business professionals and firms now-a-days

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understand how digital marketing transformed to digital marketing and the technology behind digital marketing	K1/K2/K3
2	To know the key elements of a digital marketing strategy	K2/K3
3	To understand the requirement to implement digital business such as domain registration, website development, website up gradation etc.	K2/K3/K4
4	To understand how social media can be used for business and its impacts.	K2/K3/K4
5	To know analytics tools for business summarization	K2/K3

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	**Digital Marketing**	**8-- hours**

Introduction about digital marketing- How have digital technologies transformed marketing?- Digital marketing in practice - Definitions – what are digital marketing and multichannel marketing? Paid, owned and earned media -The growing range of digital marketing platforms - The technology behind digital marketing.

Unit:2	**Digital Marketing Strategy Development**	**12-- hours**

Introduction to digital marketing strategy - Key features of digital marketing strategy -Applications of digital marketing -Benefits of digital marketing - Alternative digital business models - The difference between e-commerce and e-business - Different forms of online presence - Challenges in developing and managing digital marketing strategy - A strategic framework for developing a digital marketing strategy

Unit:3	**Digital Marketing Implementation**	**12-- hours**

Introduction : Creating effective digital experiences -Digital marketing in practice- Planning website design and redesign projects - Who should be involved in a website project? - Prototyping and agile software development - Initiation of the website project - Domain name selection and registration - Website performance optimization - Defining site or app requirements - Business requirements -

Usability requirements - Designing the information architecture -Mobile design considerations and techniques - Multichannel communications preferences - The relationship between service quality, customer.

Unit:4	**Social Media analytics**	**10-- hours**

Social Business Fundamentals - Social Media and Customer Engagement - The Social Feedback Cycle - Open Access to Information -Social Analytics - Quantitative Measurement - The Need to Measure More - Source and Sentiment Analysis - The Role of Trust - Web Analytics .-Website Performance - Business Analytics - Offline and Non business Processes - Sources of Business Analytics .

Unit:5	**Digital Marketing tools**	**8-- hours**

Different types of social media marketing tools - The medium changes the nature of standard marketing communications tools such as advertising - Selecting the right mix of digital media communications tools -Tools and techniques for collecting metrics and summarizing results - The Tools that Power a Social Graph

Unit:6	**Contemporary Issues**	**2 hours**

Expert lectures, online seminars - webinars

	Total Lecture hours	**52-- hours**

Text Book(s)

1	Dave Chaffey, Fiona Ellis-Chadwick, “Digital Marketing – Strategy, Implementation and Practice”, Pearson Education, Sixth edition, ISBN-13: 978-1292077611, 2016.
2	Social Media Marketing- the next generation of business engagement, Dave Evans and Jake McKee, Wiley Publishing , Inc. ,2010
3	Social Media Analytics Strategy- Using Data to optimize Business Performance, Alex Goncalves, Apress, 2017

Reference Books

1	Damian Ryan, Understanding Digital Marketing: Marketing Strategies for Engaging the Digital Generation Paperback – Import, Kogan Page, Fourth Edition,
2	Marketing 4.0- Moving from Traditional to Digital, Philip Kotler, Hermawan Kartajaya, Iwan Setiawan, Wiley Publishing, 2017
3	Advanced Social Media Marketing- how to lead, launch and manage a successful social media program, Tom Funk, Aprss,2013

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://www.coursera.org/learn/digital-analytics
2	https://www.tutorialspoint.com/digital_marketing/digital_marketing_web_analytics.htm

Course Designed By: Dr. K. Geetha

Mapping with Programme Outcomes

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	**S**	**S**	**S**	**S**	**M**	**M**	L	L	**M**	**S**

CO3	**S**	**S**	**S**	**S**	**M**	**M**	L	L	**M**	**S**
CO3	**S**	**S**	**S**	**S**	**M**	**M**	L	L	**M**	**S**
CO4	**S**	**S**	**S**	**S**	**M**	**M**	L	L	**M**	**S**
CO5	**S**	**S**	**S**	**S**	**M**	**M**	L	L	**M**	**S**

*S-Strong; M-Medium; L-Low


JOB
ORIENTED
COURSE

JOB ORIENTED COURSE : DATA ANALYSIS USING EXCEL	
Name of the Department	**Computer Science**
Name of the Faculty Member i/c with Complete Address with Phone and E-mail	Dr. S. Vijayarani Assistant Professor Department of Computer Science Bharathiar University, Coimbatore – 641 046 vijayarani@buc.edu.in
Inter / Intra Department Course	**Intra Department Course**
Duration of the Course	**30 Hours**
Eligibility	U.G. in Computer Science / Computer Applications / Information Technology or its equivalent
Number of Candidates to be Admitted	**30**
Mode of the Course	**Both Regular and Online**
Collaboration if any with Companies (if Yes, Full Address of the Company Address , Name of the Contact Person, Phone, e-mail etc.)	---
Registration Procedure	
Job Opportunities:	

- Data Analyst
- Data Scientist

The main objectives of this course are:

1. To understand the basics of the analysis process in Excel
2. To remember the various components and their functions in the Excel worksheet
3. To learn about advanced formulas creation and charts preparation
4. To implement different kinds of data analysis tasks
5. To handle pivot tables and macros

Expected Course Outcomes:

On the successful completion of the course, students will be able to:

1	Understand the need for MS-Excel and the working of various components	K1/K2/K4
2	Experiment with the given data by using different functions, ranges and formulas	K2/K3/K4
3	Evaluate the data analysis results and visualize them by using charts	K4/K5/K6
4	Analyze the pivot tables and the different spreadsheet tools	K4/K5
5	Create the macros and applied them for analytical tasks	K4 / K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Course Content	**Lecture / Practical / Project / Internship**	
DATA ANALYSIS USING EXCEL (30 Hours, 2 Credits)		
Module 1	**Introduction to Excel:** About Excel & Microsoft, Uses of Excel, Excel software, Spreadsheet window pane, Title Bar, Menu Bar, Standard Toolbar, Formatting Toolbar, the Ribbon, File Tab and	3 Hours

	Backstage View, Formula Bar, Workbook Window, Status Bar, Task Pane, Workbook & sheets	
Module 2	**Columns & Rows:** Selecting Columns & Rows, Changing Column Width & Row Height, Autofitting Columns & Rows, Hiding/Unhiding Columns & Rows, Inserting & Deleting Columns & Rows, Cell, Address of a cell, Components of a cell – Format, value, formula, Use of paste and paste special	3 Hours
Module 3	**Functionality Using Ranges:** Using Ranges, Selecting Ranges, Entering Information into a Range, Using AutoFill	2 Hours
Module 4	**Creating Formulas:** Using Formulas, Formula Functions – Sum, Average, if, Count, max, min, Proper, Upper, Lower, Using AutoSum	4 Hours
Module 5	**Advance Formulas:** Concatenate, Vlookup, Hlookup, Match, Countif, Text, Trim	3 Hours
Module 6	**Spreadsheet Charts:** Creating Charts, Different types of charts, Formatting Chart Objects, Changing the Chart Type, Showing and Hiding the Legend, Showing and Hiding the Data Table	4 Hours
Module 7	**Data Analysis:** Sorting, Filter, Text to Column, Data Validation	3 Hours
Module 8	**PivotTables:** Creating PivotTables, Manipulating a PivotTable, Using the PivotTable Toolbar, Changing Data Field, Properties, displaying a PivotChart, Setting PivotTable Options. Adding Subtotals to PivotTables	3 Hours
Module 9	**Spreadsheet Tools:** Moving between Spreadsheets, Selecting Multiple Spreadsheets, Inserting and Deleting Spreadsheets Renaming Spreadsheets, Splitting the Screen, Freezing Panes, Copying and Pasting Data between Spreadsheets, Hiding, Protecting worksheets	3 Hours
Module 10	**Making Macros:** Recording Macros, Running Macros, Deleting Macros	2 Hours

Text Books	
1	Hector Guerrero, Excel Data Analysis Modeling and Simulation, Second Edition, Springer, 2019
2	Berk & Carey, Data Analysis with Microsoft Excel, Brooks / Cole Cengage Learning, 2010
3	Ash Narayan Sah, Data Analysis using Microsoft Excel, Excel Books, 2009
Reference Books	
1	Stephen Nelson and Elizabeth C.Nelson, Excel Data Analysis for Dummies, 3rd Edition, John Wiley & Sons, Inc., 2016
2	Paul McDefries, Microsoft Excel Data Analysis for Dummies, John Wiley & Sons, Inc., 2019
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.coursera.org/learn/excel-data-analysis
2	https://www.datacamp.com/courses/data-analysis-in-excel
3	https://online.rice.edu/courses/excel-data-analysis
4	https://www.tutorialspoint.com/excel_data_analysis/index.htm
5	https://www.excel-easy.com/data-analysis.html

JOB ORIENTED COURSE : POWER BI FOR DATA ANALYTICS	
Name of the Department	**Computer Science**
Name of the Faculty Member i/c with Complete Address with Phone and E-mail	Dr. S. Vijayarani Assistant Professor Department of Computer Science Bharathiar University, Coimbatore – 641 046 vijayarani@buc.edu.in
Inter / Intra Department Course	**Intra Department Course**
Duration of the Course	**30 Hours**
Eligibility	U.G. in Computer Science / Computer Applications / Information Technology or its equivalent
Number of Candidates to be Admitted	**40**
Mode of the Course	**Both Regular and Online**
Collaboration if any with Companies (if Yes, Full Address of the Company Address , Name of the Contact Person, Phone, e-mail etc.)	---
Registration Procedure	
Job Opportunities:	
• Data Analyst • Data Scientist	
The main objectives of this course are: To understand the key concepts of business intelligence and the Power BI ecosystem 1. To perform different operations by using the data 2. To learn about the creation of data models and final reports 3. To understand the use of dashboards, apps and security 4. To conduct the business data analysis tasks	
Expected Course Outcomes:	
On the successful completion of the course, students will be able to:	

1	Understand the key concepts of business intelligence and Power BI Desktop	K1/K2
2	Perform data transformation tasks and create the data models	K3 / K6
3	Apply advanced visualization and create the reports	K3/K4/K6
4	Create the dashboards and apps	K4/K5/K6
5	Use data gateways and refreshing datasets.	K3/K4/K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Course Content	**Lecture / Practical / Project / Internship**
POWER BI FOR DATA ANALYTICS (30 Hours, 2 Credits)	

Module 1	**Introduction to Power BI:** Key concepts of business intelligence, The Power BI ecosystem, Power BI Licensing, Power BI Desktop and Service	3 Hours
Module 2	**Power BI Desktop:** Downloading and installing Power BI Desktop, Touring the Desktop, generating data, Creating Visualizations	3 Hours
Module 3	**Connecting and Shaping Data:** Getting data, transforming data, Merging, Copying and Appending Queries, Verifying and Loading data	2 Hours
Module 4	**Creating Data Models and Calculations:** Creating a data model, creating calculations, checking and troubleshooting calculations	4 Hours
Module 5	**Unlocking Insights:** Segmenting data, Using report navigation features, Advanced visualization techniques	3 Hours
Module 6	**Creating the final report:** Preparing the final report, creating the final report pages, Finishing up	4 Hours
Module 7	**The Service:** Getting an account, Introducing the Service, Publishing and Sharing	3 Hours
Module 8	**Using Reports in the Service:** Viewing reports, exporting reports, embedding reports, Editing and creating reports	3 Hours
Module 9	**Understanding Dashboards, Apps and Security:** Understanding dashboards, understanding apps, Understanding security and permissions	3 Hours
Module 10	**Data Gateways and Refreshing Datasets:** Installing and using data gateways, Refreshing datasets	2 Hours

Text Books

1	Greg Deckler Learn Power BI - A beginner's guide to developing interactive business intelligence solutions using Microsoft Power BI, Packt Publishing, 2019

Reference Books

1	Alberto Ferrari and Marco Russo, Introducing Microsoft Power BI, Microsoft Press, 2016
2	Devin Knight, Brian Knight, Mitchell Pearson, Manuel Quintana, Brett Powell, Microsoft Power BI Complete Reference- Bring your data to life with the powerful features of Microsoft Power BI, Packt Publishing, 2018

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://powerbi.microsoft.com/en-us/learning/
2	https://www.udemy.com/topic/microsoft-power-bi/
3	https://www.simplilearn.com/power-bi-certification-training-course
4	https://intellipaat.com/power-bi-training/
5	https://www.tutorialspoint.com/power_bi/index.htm
6	https://www.javatpoint.com/power-bi

VALUE ADDED COURSE

VALUE ADDED COURSE: SOFTWARE TESTING TOOLS			
Name of the Department		**Computer Science**	
Name of the Faculty Member i/c With Complete Address with Phone and e-mail		**Dr.K. Geetha** Assistant Professor Department of Computer Science Bharathiar University Coimbatore – 641 046. Phone **: 9965497121** E mail **: geetha.k@buc.edu.in**	
Inter / Intra Department Course		**Intra Department Course**	
Duration of the Course		**30 Hours**	
Eligibility		U.G. in Computer Science/Computer Applications/Information Technology or its equivalent	
Number of Candidates to be Admitted		40	
Registration Procedure			
Job Opportunities: Opportunities available in IT sectors			
The objectives of the Course are:			
The main objectives of this course are to:			
1	Inculcate the knowledge on the fundamentals of security		
2	Present the different types of software testing,		
3	Learn the different types of errors		
4	Examine the tools for Software Testing		
5	Testing few test cases using tool		
Course Content	Lecture / Practical / Project / Internship		
Expected Course Outcomes			
On the successful completion of the course, student will be able to:			
1	Understand and Remember the basic concepts of Software Testing		K1/K2
2	Understand and Remember the types of testing		K1/K4
3	Analyze the types of errors		K2/K4
4	Analyze and developing test cases		K2/K4/K6
5	Experimenting test cases using testing tools available as open source		K3/K4/K5
K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create			
Module 1	Introduction to Software Testing and Terminology		**2 hours**
Module 2	Types of Testing		**2 hours**

Module 3	Types of errors	**2 hours**
Module 4	Penetration testing and security	**2 hours**
Module 5	Types of Hacking	**2 hours**
Module 6	Developing test cases	**4hours**
Module 7	Unit testing - test cases	**4 hours**
Module 8	Functional testing with test cases	**4 hours**
Module 9	Security testing with test cases	**4 hours**
Module 10	Penetration testing with test cases	**4 hours**

Text Book(s)	
1	Software Testing- A Craftsman's Approach, Paul C. Jorgensen, Fourth Edition, CRC Press, 2014
2	Penetration Testing- A Hands-On Introduction to Hacking, by Georgia Weidman, No Starch Press, USA, 2014
Related Online Contents	
1	https://www.tutorialspoint.com/software_testing/index.htm
2	https://www.geeksforgeeks.org/software-testing-basics/

VALUE ADDED COURSE: CYBER SECURITY AND DIGITAL FORENSICS	
Name of the Department	**Department of Computer Science**
Name of the Faculty Member i/c With Complete Address with Phone and e-mail	**Dr. R. Porkodi** **Associate Professor** **Department of Computer Science** **Bharathiar University** **Coimbatore – 46** **0422-2428349** **porkodi_r76@buc.edu.in**
Inter / Intra Department Course	**Intra Department Course**
Duration of the Course	**30 hrs**
Eligibility	
Number of Candidates to be Admitted	**40**
Mode of the Course	**Both Regular and Online**
Collaboration if any with Companies (if Yes, Full Address of the Company Address , Name of the Contact Person, Phone, e-mail etc.)	---
Registration Procedure	
Job Opportunities:	
To become cyber security expert to identify IT breaches, vulnerabilities and threats facing companies in today's digital world.	
The objectives of the Course are:	
1	To learn the impact of Cyber security risk in an Ethical, Social, and Professional Manner
2	To provide knowledge on data acquisition methods, tools, collecting, preserving and seizing of various digital evidences.
3	To understand the security services for email
Course Outcomes:	
On the successful completion of the course, student will be able to:	
1	Understand the basics of cyber space, ethical hacking and attacks in cyber world.
2	Understand unauthorized access to digital devices and cyber psychology.
3	Study of Collection of evidences, preservation and forensic analysis.
4	Describe the digital forensics software and hardware, tools, technologies, and practices in forensics.
5	Understanding the email tracking, IP tracking, cracking of passwords and forensic analysis of different artifacts.
Course Content	Lecture / Practical / Project / Internship

Module 1	Ethical hacking, Attack Vectors, Cyberspace and Criminal Behaviour, Traditional Problems associated with Computer Crimes, brief history of the internet, contaminants and destruction of data, unauthorized access.	**3 hrs**
Module 2	Computer intrusions, white-collar crimes, viruses and malicious code, virus attacks, pornography, software piracy, mail bombs, exploitation, stalking and obscenity in internet.	**3 hrs**
Module 3	Introduction to Digital forensics, Forensic software and handling, forensic hardware and handling. Forensic analysis and its advanced tools, forensic technology and practices.	**3 hrs**
Module 4	Biometrics: face, iris and fingerprint recognition, Audio-video evidence collection, Preservation and Forensic Analysis.	**3 hrs**
Module 5	Investigation Tools, e-discovery, EDRM Models, digital evidence collection and preservation.	**3 hrs**
Module 6	Email investigation, email tracking, IP tracking, email recovery,	**3 hrs**
Module 7	search and seizure of computer systems, password cracking.	**3 hrs**
Module 8	Forensic Analysis of OS artifact, Internet Artifacts, File System Artifacts, Registry Artifacts, Application Artifacts.	**3 hrs**
Module 9	Report Writing, Mobile Forensic- identification, collection and preservation of mobile evidences.	**3 hrs**
Module 10	Social media analysis, data retrieval, Email analysis from mobile phones.	**3 hrs**

Book(s) for Study	
1	M.T.Britz, Computer Forensics and Cyber Crime, Pearson Education, 2012.
2	Charles P. Fleeger, "Security in Computing", Prentice Hall, New Delhi, 2009.
3	BehrouzA.Forouzan, Cryptography & Network Security, Tata McGraw Hill, India, New Delhi, 2009.
Book(s) for reference	
1	Bruce Schneier, Applied Cryptography, John Wiley & Sons, New York, 2004.
2	William Stallings, Cryptography and Network Security, Prentice Hall, New Delhi, 2006.
3	Neal Krawetz, Introduction to Network Security, Thomson Learning, Boston, 2007.
Related Online Contents	
1	https://www.w3schools.com › cybersecurity
2	https://www.javatpoint.com/cyber-security-tutorial
3	https://www.tutorialspoint.com/python_digital_forensics

Annexure

BHARATHIAR UNIVERSITY : : COIMBATORE 641046

DEPARTMENT OF COMPUTER SCIENCE
(Effective from the academic Year 2023 - 2024)

MISSION

- Creating and disseminating of world class knowledge in global context
- Equip students with knowledge on up-to-date technological developments to take part in global software industry
- Promote state of art inter disciplinary research in computer science
- Imbibe entrepreneurial culture through curriculum, pedagogy, research and mentoring

1. **Eligibility for Admission to the Programme**

Candidates for admission to the first-year programme leading to the Degree of Master of Science in Data Science (M.Sc. – DS) will be required to possess:

A pass in B.Sc. Computer Science or its equivalents / B.Sc. Data Science / B.Sc. Data Analytics / B.Sc. Mathematics or its equivalents / B.Sc. Statistics or its equivalents / B.Sc. Physics / B.Sc. Electronics / B.E. / B.Tech. / CSE / IT / ECE / EEE and E&I or its equivalents.

2. **Duration of the Programme**

The programme shall be offered on a full-time basis. The programme will consist of three semesters of course work, laboratory work and mini project and the fourth semester consist of project work.

3. **Regulations**

The general Regulations of the Bharathiar University Choice Based Credit System Programme are applicable to this programme.

4. **The Medium of Instruction and Examinations**

The medium of instruction and Examinations shall be in English.

5. **Submission of Record Notebooks for Practical Examinations & Project Viva-Voce.**

Candidates taking the Practical Examinations should submit Bonafide Record Note Books prescribed for the Examinations. Otherwise, the candidates will not be permitted to take the Practical Examinations.

Candidates taking the Project Viva Examination should submit Project Report prescribed for the Examinations. Otherwise, the candidates will not be permitted to take the Project Viva-voce Examination.